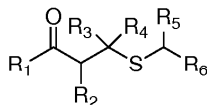


THIOETHER PRECURSORS FOR FRAGRANT KETONES AND ALDEHYDES

The present invention relates to a use of a compound of formula (I), to a composition of matter comprising a compound of formula (I) and to a consumer product comprising a compound of formula (I) according to the independent claims.



5

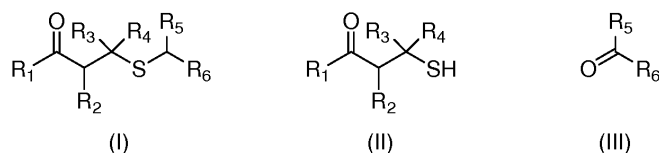
(I)

Fruity, exotic, blackcurrant or passionfruit notes are popular in perfumery and constitute attractive alternatives to hesperidic-citrus, lavender or aldehydic scents. They are not only used in fine fragrances but also in other applications, such as cosmetic, laundry and cleaning products. Representative examples of this kind of fragrance ingredient include Corps Cassis (4-(methylthio)-4-methyl-2-pentanone), Oxane ((2R, 4S)-2-methyl-4-propyl-1,3-oxathiane) and Cassyrane (5-tert-butyl-2-methyl-5-propyl-2H-furan). Generally, blackcurrant notes are top notes that consist of small molecules with a relatively low molecular weight that evaporate quickly. Since they are perceived immediately after application of a perfume, top notes are important for the initial impression thereof.

However, top notes also have a relatively low persistence and are often perceived only over a short period of time. High volatility and poor substantivity can be a problem when a prolonged effect of a fragrance is required, both in fine and functional perfumery. By way of example, laundry applications require continuous effectiveness of a perfume over a certain period of time after washing and drying of the textiles. Also in household care applications a prolonged effectiveness of perfumes can be required.

It is therefore a problem underlying the present invention to overcome these drawbacks in the prior art. In particular, it is a problem underlying the present invention to provide blackcurrant or passionfruit notes for fragrances that have an increased persistence and can be perceived over a prolonged period of time. Additionally, these notes should be versatile in application and inexpensive in production.

These problems are solved by use of a compound of formula (I) according to claim 1. Specifically, the compound of formula (I) is used as a precursor for generating a compound of formula (II) and/or a compound of formula (III).



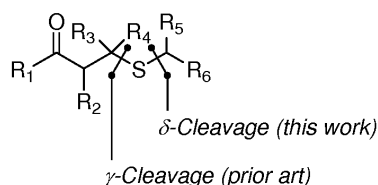
In the above formulas (I), (II) and (III), R_1 is H or C_{1-5} -alkyl; R_2 is H or C_{1-5} -alkyl; R_3 is H or C_{1-5} -alkyl; and R_4 is C_{1-6} -alkyl; or

R_1 and R_4 together with the carbon atoms to which they and R_2 are attached form a 5, 6 or 7 membered ring, preferably a hydrocarbon ring; R_2 is H or C_{1-4} -alkyl; and R_3 is H or C_{1-4} -alkyl; and wherein

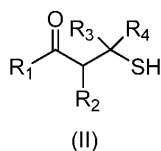
R_5 is H or a residue comprising 1 to 20 carbon atoms; and R_6 is a residue comprising 3 to 20 carbon atoms.

β -Thiocarbonyl compounds are known in the prior art as precursors for the generation of fragrance molecules, as for instance described in WO 2003/049666 A2. However, only cleavage of the bond between the sulfur atom and the carbon atom in β -position to the carbonyl group (herein referred to as " γ -cleavage") has been reported in the literature. This reaction pathway generally leads to the liberation of a corresponding α,β -unsaturated carbonyl compound (not shown here).

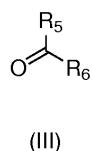
It has now been found that β -thiocarbonyl compounds according to the present invention undergo cleavage of the bond between the sulfur atom and the carbon atom in δ -position to the carbonyl group (herein referred to as " δ -cleavage").



This newly discovered reactivity allows for use of a compound of formula (I) as a precursor for generating a compound of formula (II), namely a β -thiocarbonyl compound. This is particularly useful for release of fragrance notes with an exotic, fruity, blackcurrant or passionfruit character, as discussed in further detail herein below. Depending on the structure of residues R_1 to R_4 , the odor properties of the compound of formula (II) can be adapted according to a specific application.



Another aspect of the present invention relates to the discovery that with compounds of formula (I) also carbonyl compounds of formula (III) are generated. This allows for use of a compound of formula (I) as a precursor for generating a compound of formula (III), in particular an aldehyde or a ketone. Since many perfume ingredients comprising a carbonyl group are known in the prior art, depending on the structure of residues R₅ and R₆, the odor properties of the compound of formula (III) can be adapted according to a specific application.



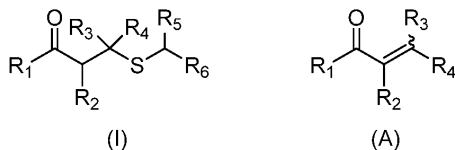
10 The compound of formula (I) can therefore also be used as a precursor for a carbonyl compound of formula (III). In a particularly useful embodiment, the compound of formula (I) can also be used as a precursor for compounds of formulas (II) and (III). In the present context, such a precursor is referred to as a “bifragrant precursor”.

The structure of residues R₁ to R₆ plays an important role with respect to the kinetics 15 for the release of the compounds of formula (II) and/or formula (III). In the context of the present invention, the compound of formula (I) may in addition to δ-cleavage also undergo γ-cleavage. By careful choice of the residues R₁ to R₆, it is possible to tune the fragrance release properties of a compound of formula (I).

The person skilled in the art is familiar with the conditions under which fragrance 20 precursors are generally used. More specifically, use of a compound of formula (I) according to the present invention commonly takes place under ambient air at a temperature of -20 °C to 100 °C, preferably -10 °C to 60 °C, even more preferably 0 °C to 40 °C, in particular at room temperature.

Another aspect of the present invention relates to a method for generating a 25 compound of formula (II) and/or a compound of formula (III) by decomposition of a compound of formula (I). The compounds of formula (I), (II) and (III) have the structures as defined herein above.

A further aspect of the present invention refers to a composition of matter comprising a compound of formula (I) and a compound of formula (A).



In the above formulas (I) and (A), R₁ is H or C₁₋₅-alkyl; R₂ is H or C₁₋₅-alkyl; R₃ is H or C₁₋₅-alkyl; and R₄ is C₁₋₆-alkyl; or

R₁ and R₄ together with the carbon atoms to which they and R₂ are attached form a 5, 6 or 7 membered ring, preferably a hydrocarbon ring; R₂ is H or C₁₋₄-alkyl; and R₃ is H or C₁₋₄-alkyl; and wherein

R₅ is H or a residue comprising 1 to 20 carbon atoms; and R₆ is a residue comprising 3 to 20 carbon atoms.

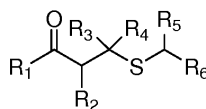
In the context of the present application, a curly bond (cf. R₃ in formula (A)) means that the configuration at a given center is undefined. The double bond in formula (A) may thus be either (E) or (Z).

In a composition of matter as specified herein above, R₁, R₂, R₃, R₄, R₅ and R₆ can be the same for both of the compound of formula (I) and the compound of formula (A), or they can be different. Preferably, they are the same.

In compositions of matter as specified herein above, it has been found that the occurrence of thiol off-odors is suppressed when a compound of formula (A) is present. Consequently, beneficial olfactory properties can be achieved.

In case the proportion of the compound of formula (A) is increased over a certain level, its odor can become prevalent and disturb the overall olfactory appearance of the composition. Thus, the amount of the compound of formula (A) in relation to the total amount of the compound of formula (I) and the compound of formula (A) is 0.1-3.0 wt.-%, preferably 0.3-1.2 wt.-%, even more preferably 0.6-1.0 wt.-%.

In yet another aspect, the present invention refers to a consumer product comprising a compound of formula (I).



(I)

In the above formula (I), R_1 is H or C_{1-4} -alkyl; R_2 is H or C_{1-4} -alkyl; R_3 is H or C_{1-4} -alkyl; and R_4 is C_{1-4} -alkyl; or

R_1 and R_4 together with the carbon atoms to which they and R_2 are attached form a 5, 6 or 7 membered ring, preferably a hydrocarbon ring; R_2 is H or C_{1-4} -alkyl; and R_3 is H or C_{1-4} -alkyl.

Furthermore, R_5 is H or a residue comprising 1 to 20 carbon atoms; and R_6 is a residue comprising 6 to 20 carbon atoms.

The total combined number of carbon atoms of R_1 , R_2 , R_3 and R_4 is 1 to 4, preferably 1 to 3.

In a use of a compound of formula (I) and/or in a composition of matter comprising a compound of formula (I) and a compound of formula (A) as specified herein above, the total combined number of carbon atoms of R_1 , R_2 , R_3 and R_4 can be 1 to 6, preferably 1 to 5, more preferably 1 to 4, even more preferably 1 to 3, irrespective of the nature of R_5 and R_6 .

This selection of residues R_1 , R_2 , R_3 and R_4 has the advantage that compounds of formula (II) generated, due to their low molecular weight, generally have a high vapor pressure which leads to an increased perception of their odor. This is particularly useful when strong fruity, blackcurrant notes are to be generated.

In a use of a compound of formula (I), in a composition of matter comprising a compound of formula (I) and a compound of formula (A), and/or in a consumer product comprising a compound of formula (I) as described herein above, R_1 , R_2 , R_3 and R_4 can have the following structures, either alone or in combination:

- R_1 can be selected from the group consisting of methyl, ethyl, n-propyl, isopropyl, n-butyl, sec-butyl and tert-butyl;
- R_2 can be selected from the group consisting of methyl, ethyl, n-propyl, isopropyl, n-butyl, sec-butyl and tert-butyl;
- R_3 can be selected from the group consisting of methyl, ethyl, n-propyl, isopropyl, n-butyl, sec-butyl and tert-butyl;

- R₄ can be selected from the group consisting of methyl, ethyl, n-propyl, isopropyl, n-butyl, sec-butyl and tert-butyl.

In a use of a compound of formula (I), in a composition of matter comprising a compound of formula (I) and a compound of formula (A), and/or in a consumer product comprising a compound of formula (I) as described herein above, the following combinations of R₁ and R₄ are particularly preferred:

- R₁ is H and R₄ is H;
- R₁ is H and R₄ is methyl;
- R₁ is methyl and R₄ is H;
- 10 – R₁ is methyl and R₄ is methyl.

In a use of a compound of formula (I), in a composition of matter comprising a compound of formula (I) and a compound of formula (A), and/or in a consumer product comprising a compound of formula (I) as described herein above, the following combination of R₁, R₂, R₃ and R₄ is particularly preferred:

- 15 – R₁ is H; R₂ is H; R₃ is H; and R₄ is methyl
- R₁ is H; R₂ is H; R₃ is methyl; and R₄ is methyl;
- R₁ is methyl; R₂ is H; R₃ is H; and R₄ is methyl;
- R₁ is methyl; R₂ is H; R₃ is methyl; and R₄ is methyl.

These compounds show a preferred release profile for ketones and aldehydes, which have proven to be useful in perfumery due their beneficial organoleptic properties. The fourth combination of residues leads to the generation of the fruity, exotic, blackcurrant and passionfruit fragrance note 4-mercapto-4-methyl-2-pentanone through δ -cleavage.

In a use of a compound of formula (I), in a composition of matter comprising a compound of formula (I) and a compound of formula (A), and/or in a consumer product comprising a compound of formula (I) as specified herein above, R₅ and R₆ can have the following structural features, either alone or in combination:

- R₅ can be a residue comprising 4 to 18 carbon atoms, preferably 6 to 16 carbon atoms;
- 30 – R₆ can be an alkyl, alkenyl or aromatic residue;

- R₆ can be a residue comprising 7 to 16 carbon atoms, preferably 8 to 14 carbon atoms, even more preferably 9 to 13 carbon atoms;
- R₆ can be an alkyl, alkenyl or aromatic residue.

In R₅ and/or R₆, the alkyl or alkenyl residues can be linear, cyclic or branched.

- 5 R₅ and/or R₆ can be hydrocarbon residues. However, they can also have one or more heteroatoms, in particular one, two or three oxygen atoms. The oxygen atoms can be part of ether and ester groups.

- In a use of a compound of formula (I), in a composition of matter comprising a compound of formula (I) and a compound of formula (A), and/or in a consumer
- 10 product comprising a compound of formula (I) according to the present invention, the compound of formula (I) can be selected from the group consisting of 3-(octylthio)butanal, 4-methyl-4-(octylthio)pentan-2-one, 3-(decylthio)butanal, 4-(decylthio)-4-methylpentan-2-one, 4-(dodecylthio)pentan-2-one, 4-(dodecylthio)-4-methylpentan-2-one, 4-(dodecylthio)-3-methylpentan-2-one, 3-(dodecylthio)-3-
- 15 methylbutanal, 3-(dodecylthio)butanal, 3-(dodecylthio)-3-methylcyclohexan-1-one, 3-(dodecylthio)-3-methylcyclopentan-1-one, 3-(tetradecylthio)butanal, 4-methyl-4-(tetradecylthio)pentan-2-one, 4-methyl-4-((6-methyloctyl)thio) pentan-2-one, 3-((3-(4-isobutyl-2-methylphenyl)propyl)thio)butanal and 4-((3-(4-isobutyl-2-methylphenyl)propyl)thio)-4-methylpentan-2-one.
- 20 These compounds can be prepared in an efficient and inexpensive manner by 1,4-addition of a linear alkylthiol to an α,β -unsaturated carbonyl compound, as will be discussed in more detail herein below. When γ -cleavage occurs as a side reaction, the thiols generated have a low vapor pressure and are therefore not perceived as a disturbing off-odor. Furthermore, the aldehydes of formula (III) that can be
- 25 concomitantly generated have by themselves an odor profile that is useful in perfumery. By means of simultaneous release, a particular impression of freshness can be achieved.

- The present invention also refers to a fragrance oil or a fragrance composition comprising a composition of matter comprising a compound of formula (I) and a
- 30 compound of formula (A) as herein defined.

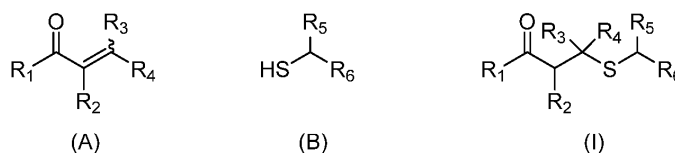
In the context of the present invention, the term “fragrance oil” is to be understood as a mixture of fragrance ingredients.

In the context of the present invention, a “fragrance composition” is to be understood as a fragrance ingredient or a fragrance oil that has been mixed with a base material.

The base material can comprise a diluent, such as diethyl phthalate (DEP), dipropylene glycol (DPG), isopropyl myristate (IPM), triethyl citrate (TEC) or an alcohol, for instance ethanol.

The present invention also relates to a consumer product comprising a composition of matter comprising a compound of formula (I) and a compound of formula (A) as specified herein above. The consumer product can be a personal care product, a laundry care product or a household care product. Examples of such products include cosmetics, shampoos, shower gels, deodorants, antiperspirants, laundry detergents, rinse conditioners, fabric softeners, detergents for dishwashers, surface cleaners, in particular for hard and soft surfaces and air care products.

Disclosed is also a method for producing a fragrance ingredient comprising a compound of formula (I) by reaction of a compound of formula (A) with a compound of formula (B).



The above-mentioned method can comprise the step of forming a mixture of the compound of formula (A) with the compound of formula (B) in a solvent, wherein the solvent is preferably an alcohol or an ether, in particular selected from the group consisting of methanol, ethanol, n-propanol, iso-propanol, n-butanol, sec-butanol, tert-butanol, diethyl ether, diisopropyl ether, di-n-butyl ether, methyl tert-butyl ether, tetrahydrofuran and 2-methyl tetrahydrofuran.

On the other hand, reaction of a compound of formula (A) with a compound of formula (B) can also be conducted in the substantial absence of a solvent.

The reaction of a compound of formula (A) with a compound of formula (B) can be conducted in the presence of a base, preferably selected from the group consisting of DBU (1,8-diazabicyclo(5.4.0)undec-7-ene), trimethylamine, trimethylamine, N,N-diisopropylethylamine and urotropine.

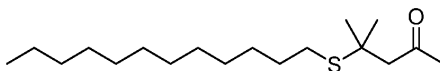
When R₁ is H, it is preferred to conduct the reaction in the substantial absence of any base and in a protic solvent, preferably an alcohol, in particular selected from the group consisting of methanol, ethanol, n-propanol, iso-propanol, n-butanol, sec-butanol, tert-butanol.

In the reaction of the compound of formula (A) with the compound of formula (B), the molar ratio of the compound of formula (A) and the compound of formula (B) can be between 5:1 and 1:1, preferably between 2:1 and 1.05:1. This has the advantage that removal of a large excess of the compound of formula (B) is avoided.

- 5 The above-mentioned method can further comprise the step of purifying the compound of formula (I) obtained, preferably by distillation, in particular wiped film distillation, or chromatography.

Further advantages and particular features of the present invention become apparent
10 from the following discussion of several examples and from the figures.

Example 1: 4-(Dodecylthio)-4-methylpentan-2-one



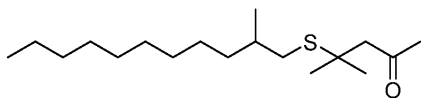
- 1-Dodecanethiol (30.0 g, 148 mmol, 1 equiv.), 4-methylpent-3-en-2-one (29.1 g, 2
15 equiv.) and DBU (22.6 g, 1 equiv.) were dissolved in THF (200 mL) and the solution was stirred for 24 h at room temperature, after which it was diluted with hexane (200 mL) and poured on 2M aqueous HCl-solution (400 mL). The organic layer was separated, washed with water and brine (pH 6), dried over MgSO₄, filtered by suction and evaporated in a rotatory evaporator. The resulting liquid was further dried under
20 high vacuum at 60°C/0.08 mbar to yield 4-(dodecylthio)-4-methylpentan-2-one as a clear, yellow liquid (44.5 g, 100%).

Odor (1% wt/vol in EtOH on blotter after 24 h): cassis, mango, passionfruit, juicy, lindenblossom

- ¹H-NMR (CDCl₃, 400MHz): 2.69 (s, 2H), 2.54 (t, J= 7.3 Hz, 2H), 2.20 (s, 3H), 1.51-
25 1.62 (m, 2H), 1.42 (s, 6H), 1.34-1.23 (m, 18H), 0.88 (t, J= 6.6 Hz, 3H).

¹³C-NMR (CDCl₃, 101MHz): 206.9 (s), 54.7 (t), 43.3 (s), 32.3 (q), 31.9 (t), 29.6 (3 t), 29.5 (2 t), 29.4 (t), 29.3 (2 t), 28.5 (2 q), 28.1 (t), 22.7 (t), 14.1 (q).

MS (EI, 70 eV): 300 (2, M⁺), 98 (15), 83 (34), 69 (16), 57 (15), 56 (15), 55 (41), 43 (100), 41 (36), 39 (16), 29 (23).

Example 2: 4-Methyl-4-((2-methylundecyl)thio)pentan-2-one

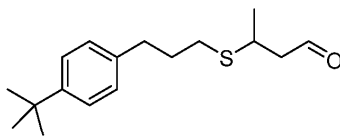
The procedure described in Example 1 was repeated with 2-methylundecane-1-thiol (preparation see B. Hache, Y. Gareau, Tetrahedron Lett. **1994**, 35(12), 1837), (8.0 g, 5 39.5 mmol, 1 equiv.), 4-methylpent-3-en-2-one (7.76 g, 2 equiv.) and DBU (6.0 g, 1 equiv.) in THF (80 mL). The crude product was purified by FC with hexane/MTBE 96:4 to yield 4-methyl-4-((2-methylundecyl)thio)pentan-2-one as a colorless liquid (5.95 g, 50%).

Odor (1% wt/vol in EtOH on blotter after 24 h): green, tomato leaves, cassis

10 ¹H-NMR (CDCl₃, 400MHz): 2.69 (s, 2 H), 2.53 (dd, J= 11.4, 5.7 Hz, 1 H), 2.38 (dd, J= 11.2, 7.3 Hz, 1 H), 2.20 (br s, 3 H), 1.56 - 1.71 (m, 1 H), 1.42 (br s, 6 H), 1.24 - 1.30 (m, 16 H), 0.98 (d, J= 6.6 Hz, 3 H), 0.89 (t, J= 6.6 Hz, 3 H).

¹³C-NMR (CDCl₃, 101MHz): 207.0 (s), 54.7 (t), 43.1 (s), 36.5 (t), 35.4 (t), 33.5 (d), 32.4 (q), 31.9 (t), 29.8 (t), 29.6 (t), 29.6 (t), 29.3 (t), 28.5 (2q), 27.0 (t), 22.7 (t), 15 19.7 (q), 14.1 (q).

MS (EI, 70 eV): 300 (2, M⁺), 201(16), 99 (22), 83 (29), 69 (15), 57 (26), 56 (15), 55 (31), 43 (100), 41 (33), 29 (19).

Example 3: 3-((3-(4-(tert-Butyl)phenyl)propyl)thio)butanal

20

3a) Preparation of 3-(4-(tert-butyl)phenyl)propane-1-thiol

This thiol was prepared by tosylation of the corresponding alcohol, nucleophilic substitution with potassium thioacetate and reduction of the thioester to the free thiol as described in the following:

25 3-(4-(tert-Butyl)phenyl)propan-1-ol (32.7 g, 170 mmol, 1 equiv.) was dissolved in MTBE (100 mL) and tosyl chloride (33.5 g, 1 equiv.) was added. The solution was cooled to 5°C, then pyridine (29.0 g, 2.1 equiv.) was added dropwise over 15 min. The

cooling bath was removed and the solution was heated to 60°C for 6 h under stirring. The solution was diluted with water and extracted with MTBE. The combined organic layers were washed with 0.5 M HCl, then with water and brine and dried over MgSO₄. The solvents were removed by rotary evaporation, and the residue was dried at room temperature at 0.08 mbar. The tosylate, a slightly yellow, viscous oil, was dissolved in DMF (170 mL) and potassium thioacetate (39.2 g, 2.0 equiv.) was added and the resulting brown suspension was heated to 80°C for 2 h, cooled to room temperature and left stirring for 16 h. The suspension was then diluted with MTBE/hexane 1:1 and washed with brine/water 1:1, then with brine. The organic layer was separated and dried over MgSO₄. After evaporation of the solvent, a dark red-brown oil was obtained (36 g) with intense sulfury smell. This product was dissolved in diethyl ether (200 mL) and added dropwise to a cooled (-10°C) suspension of LiAlH₄ (5.46 g, 144 mmol) in diethyl ether (100 mL) during 20 min. The temperature rose to 5°C. The resulting suspension was further stirred for 2 h at 5°C, then cooled to -5°C. Saturated aqueous NH₄Cl solution (50 mL) was added dropwise, which caused a strong hydrogen evolution. Upon the addition of 2 M aqueous HCl solution (80 mL), a voluminous precipitate was formed. The slurry was diluted with MTBE and water and the aqueous layer was further extracted with MTBE. The combined organic layers were washed with brine and dried over MgSO₄. The crude light brown oil (25.3 g) with strong sulfury smell obtained after removal of the solvent was used directly for the preparation of the subsequent 1,4-addition reactions.

3b) Preparation of 3-((3-(4-(tert-butyl)phenyl)propyl)thio)butanal

3-(4-(tert-Butyl)phenyl)propane-1-thiol (2.14 g, 10.2 mmol, 1 equiv.) was dissolved in EtOH (5 mL) and the solution of (E)-but-2-enal (0.9 g, 1.2 equiv.) in EtOH (3 mL) was added dropwise. The resulting solution was stirred for 3 days at room temperature, then concentrated in a rotatory evaporator under reduced pressure and the residue was purified by FC using hexane/MTBE 9:1 to yield 3-((3-(4-(tert-butyl)phenyl)propyl)thio)butanal (2.15 g, 75%) as a colorless oil.

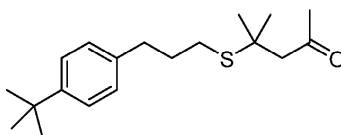
Odor (1% wt/vol in EtOH on blotter after 24 h): aldehydic, fruity, cassis

¹H-NMR (CDCl₃, 400MHz): 9.79 (t, J= 1.9 Hz, 1 H), 7.33 - 7.39 (m, 2 H), 7.14 - 7.19 (m, 2 H), 3.31 (sxt, J= 6.9 Hz, 1 H), 2.57 - 2.77 (m, 6 H), 1.95 (quin, J= 7.5 Hz, 2 H), 1.38 (d, J= 6.8 Hz, 3 H), 1.36 (s, 9 H).

¹³C-NMR (CDCl₃, 101MHz): 201.0 (s), 149.2 (s), 138.7 (s), 128.5 (2d), 125.7 (2d), 50.9 (t), 34.8 (s), 34.7 (t), 34.5 (d), 31.9 (3q), 31.6 (t), 30.5 (t), 22.2 (q).

MS (EI, 70 eV): 278 (2, M⁺), 208 (27), 193 (100), 159 (62), 131 (43), 117 (49), 115 (25), 91 (31), 57 (18), 41 (30), 39 (17).

Example 4: 4-((3-(4-(tert-Butyl)phenyl)propyl)thio)-4-methylpentan-2-one



5

The procedure described in Example 1 was repeated with 3-(4-(tert-butyl)phenyl)propane-1-thiol (prepared in example 3a) (2.12 g, 10.2 mmol, 1 equiv.), 4-methylpent-3-en-2-one (1.0 g, 1 equiv.) and DBU (1.54 g, 1 equiv.) in ethanol (5 mL). The crude product was purified by FC with hexane/MTBE 19:1 to yield 4-((3-(4-
10 (tert-butyl)phenyl)propyl)thio)-4-methylpentan-2-one as a colorless liquid (2.22 g, 71%).

Odor (1% wt/vol in EtOH on blotter after 24 h): fruity, cassis

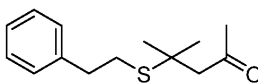
¹H-NMR (CDCl₃, 400MHz): 7.31 - 7.37 (m, 2 H), 7.13 - 7.19 (m, 2 H), 2.69 - 2.76 (m, 4 H), 2.60 (t, J=7.3 Hz, 2 H), 2.20 (s, 3 H), 1.92 (quin, J=7.3 Hz, 2 H), 1.44 (s, 6 H),
15 1.34 (s, 9 H).

¹³C-NMR (CDCl₃, 101MHz): 207.3 (s), 149.1 (s), 138.8 (s), 128.5 (2d), 125.7 (2d), 55.1 (t), 43.9 (s), 35.0 (t), 34.8 (s), 32.8 (q), 31.8 (3q), 31.5 (t), 28.9 (2q), 28.0 (t).

MS (EI, 70 eV): 306 (3, M⁺), 208 (30), 193 (100), 159 (81), 131 (42), 117 (68), 91 (39), 83 (32), 57 (42), 55 (34), 43 (75).

20

Example 5: 4-Methyl-4-(phenethylthio)pentan-2-one



The procedure described in Example 1 was repeated with 2-phenylethane-1-thiol (5.0 g, 36.2 mmol, 1 equiv.), 4-methylpent-3-en-2-one (5.5 g, 1 equiv.) and DBU (7.1 g, 2
25 equiv.) in THF (60 mL). The crude product was purified by FC with hexane/MTBE 96:4 to yield 4-methyl-4-(phenethylthio)pentan-2-one as a colorless liquid (6.33 g, 74%).

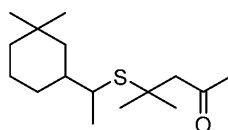
Odor (1% wt/vol in EtOH on blotter after 24 h): bee's wax, fruity, cassis

$^1\text{H-NMR}$ (CDCl_3 , 400MHz): 7.31 - 7.36 (m, 2 H), 7.22 - 7.28 (m, 3 H), 2.79 - 2.92 (m, 4 H), 2.71 (s, 2 H), 2.19 (s, 3 H), 1.46 (s, 6 H).

$^{13}\text{C-NMR}$ (CDCl_3 , 101MHz): 206.8 (s), 140.7 (s), 128.5 (2d), 128.5 (2d), 126.4 (d), 54.6 (t), 43.7 (s), 36.0 (t), 32.3 (q), 29.9 (t), 28.5 (2q).

- 5 MS (EI, 70 eV): 236 (4, M^+), 145 (18), 138 (16), 105 (31), 104 (47), 103 (12), 99 (30), 91 (65), 83 (11), 77 (14), 43 (100).

Example 6: 4-((1-(3,3-Dimethylcyclohexyl)ethyl)thio)-4-methylpentan-2-one



- 10 6a) 1-(3,3-Dimethylcyclohexyl)ethane-1-thiol

This thiol was prepared according to the procedure described in example 3a) from 1-(3,3-dimethylcyclo-hexyl)ethanol and used without purification for the subsequent reaction described in Example 6b) below.

- 6b) 4-((1-(3,3-Dimethylcyclohexyl)ethyl)thio)-4-methylpentan-2-one

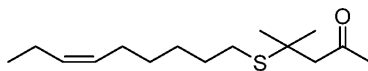
- 15 The procedure described in Example 1 was repeated with 1-(3,3-dimethylcyclohexyl)ethane-1-thiol (6.9 g, 40 mmol, 1 equiv.), 4-methylpent-3-en-2-one (7.86 g, 2 equiv.) and DBU (6.1 g, 1 equiv.) in THF (80 mL). The crude product was purified by FC with hexane/MTBE 96:4 to yield 4-((1-(3,3-dimethylcyclohexyl)ethyl)thio)-4-methylpentan-2-one as a colorless liquid (6.06 g, 56%, mixture of 2 diastereomers 96:4).

Odor (1% wt/vol in EtOH on blotter after 24 h): fruity, cassis, passionfruit

$^1\text{H-NMR}$ (CDCl_3 , 400MHz): (major diastereomer) 2.71 (s, 2 H), 2.57 - 2.65 (m, 1 H), 2.18 (s, 3 H), 1.54 - 1.81 (m, 3 H), 1.43 (2s, together 6 H), 1.31 - 1.40 (m, 3 H), 1.29 (d, $J=7.1$ Hz, 3 H), 0.93 - 1.13 (m, 3 H), 0.90 (d, $J=12.2$ Hz, 6 H).

- 25 $^{13}\text{C-NMR}$ (CDCl_3 , 101MHz): 206.9 (s), 55.4 (t), 44.3 (s), 43.2 (d), 42.4 (t), 40.2 (d), 39.2 (t), 33.5 (q), 32.4 (q), 30.8 (s), 29.8 (t), 28.9 (2q), 24.8 (q), 22.4 (t), 21.5 (q).

MS (EI, 70 eV): 270 (3, M^+), 171 (18), 138 (17), 123 (18), 99 (50), 95 (20), 83 (36), 69 (44), 55 (31), 43 (100), 41 (27).

Example 7: (Z)-4-Methyl-4-(non-6-en-1-ylthio)pentan-2-one

7a) (Z)-Non-6-ene-1-thiol

This thiol was prepared according to the procedure described in example 3a) from (Z)-non-6-en-1-ol and used without purification for the subsequent reaction described in Example 7b) below.

7b) (Z)-4-Methyl-4-(non-6-en-1-ylthio)pentan-2-one

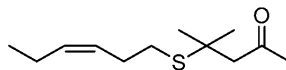
The procedure described in Example 1 was repeated with (Z)-non-6-ene-1-thiol (6.2 g, 39.2 mmol, 1 equiv.), 4-methylpent-3-en-2-one (7.69 g, 2 equiv.) and DBU (5.96 g, 10 equiv.) in THF (80 mL). The crude product was purified by FC with hexane/MTBE 96:4 to yield 4-((1-(3,3-dimethylcyclohexyl)ethyl) thio)-4-methylpentan-2-one as a colorless liquid (6.12 g, 61%).

Odor (1% wt/vol in EtOH on blotter after 24 h): green, fruity, cassis

$^1\text{H-NMR}$ (CDCl_3 , 400MHz): 5.25 - 5.45 (m, 2 H), 2.69 (s, 2 H), 2.54 (t, $J=7.6$ Hz, 2 H), 2.20 (s, 3 H), 1.97 - 2.10 (m, 4 H), 1.52 - 1.64 (m, 2 H), 1.42 (s, 6 H), 1.34 - 1.45 (m, 4 H), 0.96 (t, $J=7.5$ Hz, 3 H).

$^{13}\text{C-NMR}$ (CDCl_3 , 101MHz): 206.9 (s), 131.8 (d), 128.9 (d), 54.7 (t), 43.3 (s), 32.3 (q), 29.4 (t), 29.4 (t), 28.9 (t), 28.5 (2q), 28.1 (t), 26.9 (t), 20.5 (t), 14.4 (q).

MS (EI, 70 eV): 157 (31), 101 (16), 99 (22), 87 (20), 83 (17), 67 (16), 55 (27), 43 (100), 41 (30), 39 (15).

Example 8: (Z)-4-(Hex-3-en-1-ylthio)-4-methylpentan-2-one

8a) (Z)-Hex-3-ene-1-thiol

This thiol was prepared according to the procedure described in example 3a) from (Z)-hex-3-en-1-ol and used without purification for the subsequent reaction described in Example 8b) below.

8b) (Z)-4-(Hex-3-en-1-ylthio)-4-methylpentan-2-one

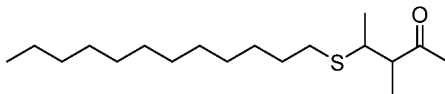
The procedure described in Example 1 was repeated with (Z)-Hex-3-ene-1-thiol (2.8 g, 24.1 mmol, 1 equiv.), 4-methylpent-3-en-2-one (4.73 g, 2 equiv.) and DBU (3.67 g, 1 equiv.) in THF (60 mL). The crude product was purified by FC with hexane/MTBE 96:4 to yield (Z)-4-(hex-3-en-1-ylthio)-4-methylpentan-2-one as a slightly yellow liquid (2.23 g, 43%).

Odor (1% wt/vol in EtOH on blotter after 24 h): fresh green, fruity, cassis

¹H-NMR (CDCl₃, 400MHz): 5.31 - 5.50 (m, 2 H), 2.70 (s, 2 H), 2.55 - 2.59 (m, 2 H), 2.26 - 2.34 (m, 2 H), 2.19 (s, 3 H), 2.00 - 2.10 (m, 2 H), 1.43 (s, 6 H), 0.97 (t, J= 7.5 Hz, 3 H).

¹³C-NMR (CDCl₃, 101MHz): 206.8 (s), 133.2 (d), 126.9 (d), 54.6 (t), 43.4 (s), 32.3 (q), 28.5 (2q), 28.2 (t), 27.2 (t), 20.6 (t), 14.2 (q).

MS (EI, 70 eV): 115 (48), 99 (31), 87 (10), 83 (8), 82 (9), 67 (11), 55 (14), 43 (100), 41 (22), 39 (12).

Example 9: 4-(Dodecylthio)-3-methylpentan-2-one

The procedure described in Example 1 was repeated with 1-dodecanethiol (7.0 g, 34.6 mmol, 1 equiv.), (E)-3-methylpent-3-en-2-one (6.79 g, 2 equiv.) and DBU (5.27 g, 1 equiv.) in THF (60 mL). The crude product was purified by FC with hexane/MTBE 95:5 to yield 4-(dodecylthio)-3-methylpentan-2-one as a colorless liquid (9.4 g, 90%).

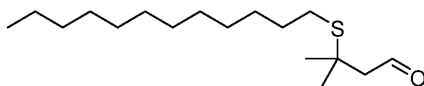
Odor (1% wt/vol in EtOH on blotter after 24 h): fruity, cassis

¹H-NMR (CDCl₃, 400MHz): (mixture of 2 diastereomers 48:52) 2.96 - 3.13 (m, 1 H), 2.57 - 2.73 (m, 1 H), 2.53 (t, J= 7.5 Hz, 2 H), 2.22 (s, 1.5H), 2.21 (s, 1.5H), 1.53 - 1.63 (m, 2 H), 1.30 (d, J= 6.8 Hz, 1.5 H), 1.25-1.40 (m, 18 H), 1.23 (d, J= 7.0, 1.5 H), 1.22 (d, J= 7.0, 1.5 H), 1.13 (d, J= 6.8 Hz, 1.5 H), 0.87 - 0.92 (m, 3 H).

¹³C-NMR (CDCl₃, 101MHz): (mixture of 2 diastereomers 48:52) 211.1 (s), 210.7 (s), 52.5 (d), 51.9 (d), 42.6 (d), 41.1 (d), 31.9 (t), 31.4 (t), 31.0 (t), 29.8 (t), 29.7 (t), 29.7 (t), 29.6 (t), 29.6 (t), 29.5 (t), 29.3 (t), 29.2 (t), 29.0 (t), 22.7 (t), 20.5 (q), 18.0 (q), 14.4 (q), 14.1 (q), 12.8 (q).

MS (EI, 70 eV): 300 (5, M⁺), 229 (20), 99 (40), 98 (24), 83 (29), 69 (25), 57 (19), 55 (51), 43 (100), 41 (40), 29 (24).

Example 10: 3-(Dodecylthio)-3-methylbutanal



5

The procedure described in Example 1 was repeated with 1-dodecanethiol (24.1 g, 119 mmol, 1 equiv.), 3-methylbut-2-enal (10.0 g, 1 equiv.) and DBU (18.1 g, 1 equiv.) without solvent. The crude product was purified by FC with hexane/MTBE 95:5 to yield 3-(dodecylthio)-3-methylbutanal as a colorless liquid (7.0 g, 21%).

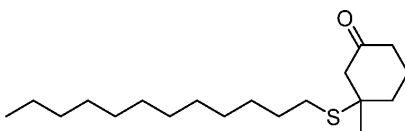
10 Odor (1% wt/vol in EtOH on blotter after 24 h): cassis, sulfury

¹H-NMR (CDCl₃, 400MHz): 9.87 (t, J=2.9 Hz, 1 H), 2.53 - 2.58 (m, 4 H), 1.52 - 1.63 (m, 2 H), 1.45 (s, 6 H), 1.28-1.41 (m, 18 H), 0.90 (t, J=6.8 Hz, 3 H).

¹³C-NMR (CDCl₃, 101MHz): 202.0 (d), 54.6 (t), 42.7 (s), 32.3 (t), 30.0 (t), 30.0 (t), 30.0 (t), 29.9 (t), 29.8 (t), 29.7 (2q), 29.6 (2t), 29.6 (s), 28.4 (t), 23.1 (t), 14.5 (q).

15 MS (EI, 70 eV): 286 (2, M⁺), 97 (35), 84 (50), 83 (54), 70 (32), 69 (47), 57 (89), 56 (73), 55 (100), 43 (53), 41 (77).

Example 11: 3-(Dodecylthio)-3-methylcyclohexan-1-one



20 The procedure described in Example 1 was repeated with 1-dodecanethiol (7.7 g, 38.0 mmol, 1 equiv.), 3-methyl-2-cyclohexen-1-one (5.03 g, 1.2 equiv.) and DBU (5.79 g, 1 equiv.) in THF (60 mL) during 4 days at room temperature. The crude product was purified by FC with hexane to hexane/MTBE 9:1 to yield 3-(dodecylthio)-3-methylcyclohexan-1-one as a colorless liquid (3.09 g, 26%).

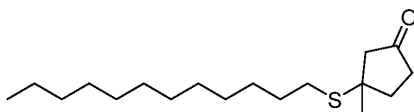
25 Odor (1% wt/vol in EtOH on blotter after 24 h): aldehydic, floral, green, slightly sulfury

$^1\text{H-NMR}$ (CDCl_3 , 400MHz): 2.53 - 2.58 (m, 1 H), 2.44 - 2.52 (m, 2 H), 2.34 - 2.43 (m, 2 H), 2.08 - 2.30 (m, 2 H), 1.77 - 2.01 (m, 3 H), 1.51 - 1.61 (m, 2 H), 1.40 (s, 3 H), 1.27-1.42 (m, 18 H), 0.89 (t, $J=6.8$ Hz, 3 H).

$^{13}\text{C-NMR}$ (CDCl_3 , 101MHz): 208.9 (s), 53.5 (t), 48.3 (s), 40.3 (t), 36.8 (t), 31.9 (t),
5 29.6 (t), 29.6 (t), 29.6 (t), 29.5 (t), 29.4 (t), 29.3 (t), 29.2 (t), 29.2 (t), 28.8 (q),
27.4 (t), 22.7 (t), 22.1 (t), 14.1 (q).

MS (EI, 70 eV): 312 (1, M^+), 112 (21), 111 (100), 110 (36), 83 (30), 82 (56), 69 (29),
55 (78), 43 (32), 41 (42), 39 (22).

10 Example 12: 3-(Dodecylthio)-3-methylcyclopentan-1-one



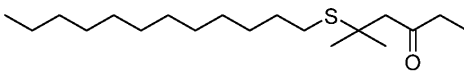
The procedure described in Example 1 was repeated with 1-dodecanethiol (8.7 g, 43.0 mmol, 1 equiv.), 3-methylcyclopent-2-enone (4.96 g, 1.2 equiv.) and DBU (6.54 g, 1 equiv.) in THF (60 mL) during 4 days at room temperature. The crude product was
15 purified by FC with hexane to hexane/MTBE 9:1 to yield 3-(dodecylthio)-3-methylcyclopentan-1-one as a colourless liquid (0.68 g, 5%).

Odor (1% wt/vol in EtOH on blotter after 24 h): fruity, sulfury

$^1\text{H-NMR}$ (CDCl_3 , 400MHz): 2.44 - 2.63 (m, 4 H), 2.16 - 2.37 (m, 3 H), 1.93 - 2.05 (m, 1 H), 1.56 (s, 3 H), 1.54-1.63 (m, 2 H), 1.28-1.38 (m, 18 H), 0.90 (t, $J=6.6$ Hz, 3 H).

20 $^{13}\text{C-NMR}$ (CDCl_3 , 101MHz): 216.9 (s), 52.7 (t), 49.1 (s), 36.9 (t), 36.1 (t), 31.9 (t),
29.6 (t), 29.6 (t), 29.6 (t), 29.5 (t), 29.3 (t), 29.2 (t), 29.2 (t), 28.8 (t), 28.3 (q),
22.7 (t), 14.1 (q).

MS (EI, 70 eV): 298 (4, M^+), 201 (19), 97 (100), 96 (41), 83 (19), 69 (52), 67 (19),
55 (35), 43 (32), 41 (48), 39 (18).

Example 13: 5-(Dodecylthio)-5-methylhexan-3-one

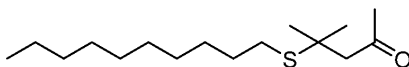
The procedure described in Example 1 was repeated with 1-dodecanethiol (4.9 g, 24.2 mmol, 1 equiv.), 5-methylhex-4-en-3-one (5.43 g, 2 equiv.) and DBU (3.69 g, 1 equiv.) in THF (80 mL) during 20 h at room temperature. The crude product was purified by FC with hexane/MTBE 96:4 to yield 5-(dodecylthio)-5-methylhexan-3-one as a colourless liquid (3.45 g, 46%).

Odor (1% wt/vol in EtOH on blotter after 24 h): fruity, sulfury, slightly aldehydic

¹H-NMR (CDCl₃, 400MHz): 2.68 (s, 2 H), 2.54 (t, J= 7.3 Hz, 2 H), 2.50 (q, J= 7.3 Hz, 2 H), 1.52 - 1.62 (m, 2 H), 1.43 (s, 6 H), 1.27 (1.42-1.20, m, 18 H), 1.05 (t, J= 7.2 Hz, 3 H), 0.89 (t, J= 6.6 Hz, 3 H).

¹³C-NMR (CDCl₃, 101MHz): 209.5 (s), 53.6 (t), 43.5 (s), 38.2 (t), 31.9 (t), 29.7 (t), 29.6 (t), 29.6 (t), 29.6 (t), 29.5 (t), 29.3 (t), 29.3 (2t), 28.6 (2q), 28.2 (t), 22.7 (t), 14.1 (q), 7.6 (q).

MS (EI, 70 eV): 314 (3, M+), 257 (3), 243 (7), 201 (8), 113 (11), 97 (13), 83 (57), 69 (17), 57 (100), 43 (31), 29 (29).

Example 14: 4-(Decylthio)-4-methylpentan-2-one

The procedure described in Example 1 was repeated with 1-decanethiol (10.0 g, 57.4 mmol, 1 equiv.), 4-methylpent-3-en-2-one (11.26 g, 2 equiv.) and DBU (8.73 g, 1 equiv.) in THF (80 mL) during 24 h at room temperature. The crude product was purified by FC with hexane/MTBE 95:5 to yield 4-(decylthio)-4-methylpentan-2-one as a colourless liquid (14.12 g, 90%).

Odor (1% wt/vol in EtOH on blotter after 24 h): fruity, sulfury, slightly aldehydic.

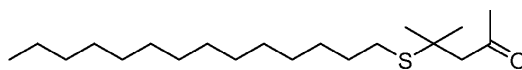
¹H-NMR (CDCl₃, 400MHz): 2.70 (s, 2 H), 2.54 (t, J= 7.8 Hz, 2 H), 2.20 (s, 3 H), 1.52 - 1.62 (m, 2 H), 1.43 (s, 6 H), 1.27 (1.43 - 1.23, m, 14 H), 0.89 (t, J= 6.6 Hz, 3 H).

¹³C-NMR (CDCl₃, 101MHz): 206.9 (s), 54.7 (t), 43.3 (s), 32.4 (q), 31.9 (t), 29.5 (t), 29.5 (t), 29.5 (t), 29.3 (t), 29.3 (t), 29.3 (t), 28.5 (2q), 28.1 (t), 22.7 (t), 14.1 (q).

MS (EI, 70 eV): 272 (6, M⁺), 173 (17), 140 (4), 99 (26), 83 (24), 69 (9), 55 (23), 43 (100), 29 (11).

Example 15: 4-Methyl-4-(tetradecylthio)pentan-2-one

5



The procedure described in Example 1 was repeated with 1-tetradecanethiol (4.16 g, 18.1 mmol, 1 equiv.), 4-methylpent-3-en-2-one (3.54 g, 2 equiv.) and DBU (2.75 g, 1 equiv.) in THF (50 mL) during 24 h at room temperature. The crude product was purified by FC with hexane/MTBE 95:5 to yield 4-methyl-4-(tetradecylthio)pentan-2-one as a colourless liquid (3.21 g, 54%).

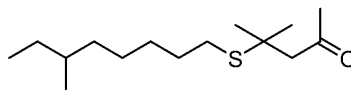
Odor (1% wt/vol in EtOH on blotter after 24 h): fruity, sulfury, slightly aldehydic

¹H-NMR (CDCl₃, 400MHz): 2.70 (s, 2 H), 2.54 (t, J= 7.6 Hz, 2 H), 2.21 (s, 3 H), 1.53 - 1.62 (m, 2 H), 1.43 (s, 6 H), 1.25 - 1.42 (m, 22 H), 0.89 (t, J= 6.8 Hz, 3 H).

¹³C-NMR (CDCl₃, 101MHz): 206.9 (s), 54.7 (t), 43.3 (s), 32.4 (q), 31.9 (t), 29.7 (t), 29.7 (t), 29.7 (2t), 29.6 (t), 29.5 (t), 29.5 (t), 29.4 (t), 29.3 (2t), 28.5 (2q), 28.1 (t), 22.7 (t), 14.1 (q).

MS (EI, 70 eV): 328 (3, M⁺), 285 (4), 271 (3), 229 (11), 168 (2), 111 (8), 99 (27), 83 (46), 69 (21), 55 (39), 43 (100), 29 (15).

20 Example 16: 4-Methyl-4-((6-methyloctyl)thio)pentan-2-one



The procedure described in Example 1 was repeated with 6-methyloctane-1-thiol (prepared according to Example 3a) from 6-methyl octanol; 8.5 g, 53 mmol, 1 equiv.), 4-methylpent-3-en-2-one (10.4 g, 2 equiv.) and DBU (8.07 g, 1 equiv.) in THF (120 mL). The crude product was purified by FC with hexane/MTBE 96:4 to yield 4-methyl-4-((6-methyloctyl)thio)pentan-2-one as a clear, colorless liquid (9.3 g, 68%).

Odor (1% wt/vol in EtOH on blotter after 24 h): fruity, cassis, slightly aldehydic

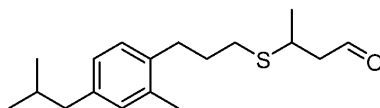
¹H-NMR (CDCl₃, 400 MHz): 2.69 (s, 2 H), 2.59 (br. t, J = 7.5 Hz, 2 H), 2.19 (s, 3 H), 1.52 - 1.63 (m, 2 H), 1.42 (s, 6 H), 1.22 - 1.41 (m, 7 H), 1.06 - 1.19 (m, 2 H), 0.85 (t, J = 7.2 Hz, 3H), 0.84 (d, J = 6.0 Hz, 3H).

¹³C-NMR (CDCl₃, 101 MHz): 206.9 (s), 54.7 (t), 43.3 (s), 36.4 (t), 34.3 (d), 32.3 (q),
5 29.6 (t), 29.6 (t), 29.4 (t), 28.5 (2q), 28.1 (t), 26.7 (t), 19.2 (q), 11.4 (q).

MS (EI, 70 eV): 258 (3, M⁺), 159 (12), 99 (22), 97 (15), 83 (22), 69 (11), 57 (16), 55 (28), 43 (100), 41 (25), 29 (19).

Example 17: 3-((3-(4-isobutyl-2-methylphenyl)propyl)thio)butanal

10



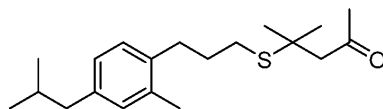
The procedure described in Example 3b) was repeated with 3-(4-isobutyl-2-methylphenyl)propane-1-thiol (prepared according to Example 3a) from 3-(4-isobutyl-2-methylphenyl)propan-1-ol { prepared as described in WO 2014/180945 A1 } ; 5.1 g, 22.9 mmol, 1 equiv.) and (E)-but-2-enal (3.21 g, 2 equiv.). The crude product was
15 purified by FC with hexane/MTBE 94:6 to yield 3-((3-(4-isobutyl-2-methylphenyl)propyl)thio)butanal as a clear, colorless liquid (0.39g, 6%).

Odor (1% wt/vol in EtOH on blotter after 24 h): aldehydic, sulfury

¹H-NMR (CDCl₃, 400 MHz): 9.80 (t, J=2.0 Hz, 1 H), 7.06 (d, J=7.6 Hz, 1 H), 6.92 - 6.98 (m, 2 H), 3.32 (sxt, J=6.8 Hz, 1 H), 2.58 - 2.74 (m, 6 H), 2.44 (d, J=7.1 Hz, 2
20 H), 2.32 (s, 3 H), 1.83 - 1.94 (m, 3 H), 1.38 (d, J=6.6 Hz, 3 H), 0.93 (d, J=6.6 Hz, 6 H).

¹³C-NMR (CDCl₃, 101 MHz): 200.6 (d), 139.4 (s), 136.7 (s), 135.4 (s), 131.1 (d), 128.6 (d), 126.7 (d), 50.5 (t), 45.0 (t), 34.1 (d), 32.0 (t), 30.4 (t), 30.2 (d), 30.1 (t), 21.7 (2q), 22.5 (q), 19.4 (q).

25 MS (EI, 70 eV): 292 (5, M⁺), 222 (35), 188 (17), 179 (47), 161 (36), 145 (100), 131 (43), 119 (41), 105 (19), 91 (15), 61 (9), 41 (24).

Example 18: 4-((3-(4-isobutyl-2-methylphenyl)propyl)thio)-4-methylpentan-2-one

The procedure described in Example 1 was repeated with 3-(4-isobutyl-2-methylphenyl)propane-1-thiol (prepared according to Example 3a) from 3-(4-isobutyl-2-methylphenyl)propan-1-ol { prepared as described in WO 2014/180945 A1} ; 5.1 g, 22.9 mmol, 1 equiv.), 4-methylpent-3-en-2-one (4.5 g, 2 equiv.) and DBU (3.49 g, 1 equiv.) in THF (50 mL). The crude product was purified by Kugelrohr distillation (140-165°C, 0.02 mbar) to yield 4-((3-(4-isobutyl-2-methylphenyl)propyl) thio)-4-methylpentan-2-one as a clear, colorless liquid (3.6 g, 49%).

10 Odor (1% wt/vol in EtOH on blotter after 24 h): fruity, cassis, sulfury

¹H-NMR (CDCl₃, 400 MHz): 7.06 (d, J=7.6 Hz, 1 H), 6.91 - 6.97 (m, 2 H), 2.68 - 2.74 (m, 4 H), 2.62 (t, J=7.3 Hz, 2 H), 2.43 (d, J=7.3 Hz, 2 H), 2.31 (s, 3 H), 2.21 (s, 3 H), 1.82 - 1.92 (m, 3 H), 1.45 (s, 6 H), 0.92 (d, J=6.6 Hz, 6 H).

¹³C-NMR (CDCl₃, 101 MHz): 206.9 (s), 139.4 (s), 136.8 (s), 135.4 (s), 131.1 (d), 128.6 (d), 126.6 (d), 54.7 (t), 45.0 (t), 43.5 (s), 32.3 (d), 32.3 (t), 30.2 (q), 30.1 (t), 28.5 (2q), 27.9 (t), 22.4 (2q), 19.3 (q).

MS (EI, 70 eV): 320 (6, M⁺), 222 (27), 188 (44), 179 (37), 161 (50), 145 (100), 131 (60), 119 (43), 105 (20), 83 (24), 57 (14), 55 (23), 41 (79).

20 Example 19: Release of odoriferous volatiles from 4-(dodecylthio)-4-methylpentan-2-one

A 10% wt/wt solution of 4-(dodecylthio)-4-methylpentan-2-one (prepared according to Example 1) in MTBE (200 µl, 16.3 mg) was applied on a paper blotter (4x1.2 cm², conditioned by rinsing with MeOH and vacuum drying). After 5 min evaporation of the solvent in open air, the blotter was placed at the bottom of a 2 L glass jar closed with a lid containing two openings which were sealed with Parafilm. The glass jar was left for 48 h at 25°C in a cabinet lit with a fluorescent UV A/B-light source (ca. 0.8 mW/cm²).

Then a stainless steel tube (length 25 cm, i.d. 0.8 mm) with a Porapak Q filter (cf. R. Kaiser, "Meaningful Scents around the World", Helvetica Chimica Acta, Zürich 2006, chapter 1.3.) attached to its tip with shrinking tube and secured with Parafilm, was

introduced into the jar through one of the openings, to which it was attached by an air-tight Teflon joint. The tube was attached to a peristaltic pump with a thin rubber hose and the other opening of the jar (the air inlet) was equipped with a charcoal filter. An air volume of 2 L was drawn through the filter with a flow of 10 mL/min. The trapped
5 volatiles were desorbed with 100 µL of MTBE and the liquid sample was analysed by GC/MS and GC-sniff. As shown in Fig. 1, the presence of the odorants 4-mercapto-4-methylpentan-2-one and dodecanal was detected among the volatiles released from 4-(dodecylthio)-4-methylpentan-2-one.

10 Example 20: Release of odoriferous volatiles from 3-((3-(4-(tert-butyl)phenyl)propyl)thio)butanal

Example 19 was repeated with 3-((3-(4-(tert-butyl)phenyl)propyl)thio)butanal. The presence of the odorant 3-(4-(tert-butyl)phenyl)propanal was detected among the volatiles released from 3-((3-(4-(tert-butyl)phenyl)propyl)thio)butanal (Fig. 2).

15

Example 21: Release of odoriferous volatiles from 4-((3-(4-(tert-butyl)phenyl)propyl)thio)-4-methylpentan-2-one

Example 19 was repeated with 4-((3-(4-(tert-butyl)phenyl)propyl)thio)-4-methylpentan-2-one. The presence of the odorants 4-mercapto-4-methylpentan-2-one
20 and 3-(4-(tert-butyl)phenyl)propanal was detected among the volatiles released from 4-((3-(4-(tert-butyl)phenyl)propyl)thio)-4-methylpentan-2-one (Fig. 3).

Example 22: A fresh clean citrus fragrance for an all-purpose cleaner

The following fragrance accord has been created for an all-purpose cleaner and is to be
25 assessed at 0.3% in the unperfumed product base.

CAS number	Ingredient name	Amount parts wt/wt
140-11-4	Benzyl acetate	15
80-26-2	Terpenyl Acetate	60
101-86-0	alpha Hexyl Cinnamic Aldehyde	30
112-31-2	Decanal	18

67634-00-8	Allyl amyl glycolate	3
1092785-58-4	Cassyrane™ (Givaudan)	0.5
106-22-9	Citronellol	20
68039-49-6	Cyclal C	5
57378-68-4	delta Damascone	1
65405-70-1	4- E-Decenal	0.2
18479-58-8	Dihydro Myrcenol	60
8000-48-4	Eucalyptus Essence	10
67634-14-4	Floralozone	3
125109-85-5	Florhydral	2
14765-30-1	Freskomenthe	5
54464-57-2	Iso E Super	20
20665-85-4	Isobutavan	0.2
1335-46-2	Isoraldeine 70	10
198404-98-7	Javanol	1
81783-01-9	Labienoxime 1% in TEC/IPM	3
61792-11-8	Lemonile	35
73018-51-6	Lime Oxide	20
78-70-6	Linalool	90
39255-32-8	Manzanate	2
37677-14-8	Myraldene	10
1637294-12-2	Nympheal	8
68647-72-3	Orange Terpenes	300
916887-53-1	Petalia™ (Givaudan)	7
313973-37-4	Pharaone™ (Givaudan) 10% in DPG	4
82461-14-1	Rhubafuran	0.5
1655500-83-6	Rosyfolia™ (Givaudan)	3
16510-27-3	Toscanol™ (Givaudan)	1

	Reference Accord	Accord A	Accord B
4-(dodecylthio)-4-methylpentan-	0	2	10

2-one (Example 1)				
25265-71-8	Dipropylene Glycol	252.6	250.6	242.6
Total parts wt/wt		1000	1000	1000

The olfactory character imparted to the product by the reference accord is citrus and fresh floral aldehydic, with a watery facette.

- Addition of 0.2% of 4-(dodecylthio)-4-methylpentan-2-one (Example 1) enhances the citrus odor aspect, while addition of 1% renders the accord more intense citrus and enhances the juicy aspect. After 24 hours application on a floor tile, the perfume is slightly more intense with the addition of 0.2% 4-(dodecylthio)-4-methylpentan-2-one and clearly more intense, fresher and juicier than the reference with 1%.

10 Example 23: Olfactive evaluation of compound according to Example 1 and mixtures thereof with mesityl oxide

Mixtures of the compound according to Example 1 (4-(dodecylthio)-4-methylpentan-2-one) with mesityl oxide were prepared in different ratios and subjected to olfactive evaluation. All samples were assessed as 10% solutions in ethanol on a fresh blotter.

Sample	Olfactive evaluation
4-(dodecylthio)-4-methylpentan-2-one	cassis, sulphur, eucalyptus bud, overall sulphurous impression is dominant, polarizing
4-(dodecylthio)-4-methylpentan-2-one, spiked with 0.01 wt.-% or 0.03 wt.-% mesityl oxide	effect is minor, and olfactive profile still very close to pure material
4-(dodecylthio)-4-methylpentan-2-one, spiked with 0.1 wt.-% mesityl oxide	combination starts to bring a positive olfactive benefit
4-(dodecylthio)-4-methylpentan-2-one, spiked with 0.3 wt.-% mesityl oxide	combination brings a positive olfactive benefit, more juicy, more pleasant
4-(dodecylthio)-4-methylpentan-2-one, containing 0.8% mesityl oxide	fruity juicy cassis, juicy, pleasant
4-(dodecylthio)-4-methylpentan-2-one, spiked with 1.0 wt.-% mesityl oxide	combination brings a positive olfactive benefit, more juicy
4-(dodecylthio)-4-methylpentan-2-one, spiked with 3.0 wt.-% mesityl oxide	mesityl oxide starts to dominate, and brings an additional green and technical facet
mesityl oxide	green, solvent, plastic like, then fruity, almondy, cherry

The above results show that there is an optimum ratio between 4-(dodecylthio)-4-methylpentan-2-one and mesityl oxide, in which the mixture shows superior olfactive properties.

5 Example 24: Application in liquid detergent 1

Three samples of liquid detergent samples (34 g each) were prepared by adding 0.2 wt.-% of the following precursors according to the present invention to a non fragrancd heavy duty liquid detergent base (pH 8.4): 4-(decylthio)-4-methylpentan-2-one (Example 14), 4-(dodecylthio)-4-methylpentan-2-one (Example 1) and 4-methyl-4-(tetradecylthio)pentan-2-one (Example 15). The samples were used to wash a load of 5 cotton terry towels (ca. 200 g dry weight each, 1.1 kg total load) in a standard frontloading washing machine. The wash cycle was carried out at 40°C, followed by two cold rinse cycles and spinning at 1000 rpm. The washed towels were assessed blind by a panel of 6 experienced evaluators for fragrance intensity on wet towel and after 24 h line dry at room temperature. The intensity was indicated on a scale from 0 (odorless) to 5 (very strong).

Ingredient	Fragrance intensity on wet towel	Fragrance intensity on dry towel (24 h line dry)
4-(decylthio)-4-methylpentan-2-one	1.5	0.8
4-(dodecylthio)-4-methylpentan-2-one	1.2	2.1
4-methyl-4-(tetradecylthio)pentan-2-one	1.0	1.3

As can be seen from the results provided in the table above, the comparative study of three precursors according to the present invention with $R_1 = R_3 = R_4 = \text{methyl}$, $R_2 = R_5 = \text{H}$ and $R_6 = \text{nonyl, undecyl or tridecyl}$, the strongest precursor effect was observed with $R_6 = \text{undecyl}$. The observed differences between $R_6 = \text{undecyl}$ and $R_6 = \text{nonyl}$ or $R_6 = \text{tridecyl}$ were significant at confidence levels of 99.8% and 96%, respectively.

Due to the high volatility and water solubility of the released odorant 4-mercapto-4-methyl-2-pentanone ($\text{clogP} = 1.0$, as compared to $\text{clogP} = 7.2$ for 4-(dodecylthio)-4-methylpentan-2-one), it would not have been technically possible to deposit a sufficient amount of the material on fabric to trigger a fragrance impact.

Example 25: Application in liquid detergent 2

a) General

As series of experiments was conducted in order to determine whether fragrance ingredients according to the present invention show intensity benefits in fabric
5 detergents. The compound of Example 1 (4-(dodecylthio)-4-methylpentan-2-one) was tested with two fragrances A and B, which had different olfactive profiles. The products were assessed on wet cloth and on 1 day, 3 days and 7 days dried cloth.

The members of a sensory analysis panel were selected on a basis of their olfactory sensory acuity and then trained for several months. Their training enabled them to
10 identify individual odor characteristics and score their perceived intensity against given standards in a consistent manner.

The fabrics were washed in European washing machines (40°C – 1,000 spin/min) with one unit dose per wash load. For the wet stage, after washing, the cloths were placed into 500 mL wide necked glass jars ready for assessment. For the dry cloth
15 assessment, the cloth was lined-dried and left overnight in a perfume free room at 25 °C. Cloths washed with fragrance A were used as the control.

For all stages the overall perceived intensity was assessed by the trained sensory panel using a 0-100 linear scale. All overall perceived intensities were scaled against a reference sample A, for which the overall perceived intensity was set at 35 for wet
20 cloth assessment and 10 for the dry cloth assessments where the reference sample was a 1 day dry cloth. The reference sample A was presented in the same format as the test samples for the wet cloth and dry cloth assessment.

For the wet cloth assessment, each sample was assessed twice by 20 panellists, thus giving 40 assessments per product. For the 1 day, 3 days and 7 days dry cloth
25 assessments, each sample was assessed twice by 14 panellists, thus giving 28 assessments per product.

The estimated product means are reported on the next pages, together with any statistically significant differences between products.

b) Wet Cloth

Product	Overall Perceived Intensity	Significance of Differences
Fragrance A	35.7	A
Fragrance A + 2% Precursor	35.8	A
Fragrance B	44.6	B
Fragrance B + 2% Precursor	45.2	B

Where the same letter is shown in the “significance of differences” column there are no statistically significant differences between the relevant figures.

- When assessed from wet cloth, cloth washed with Fragrance B or Fragrance B + 2% precursor were not perceived to be significantly different, but were perceived to be significantly stronger than cloth washed with Fragrance A or Fragrance A + 2% precursor, which were also not perceived to be significantly different to each other.

c) Dry cloth 1 day

Product	Overall Perceived Intensity	Significance of Differences
Fragrance A	10.9	A
Fragrance A + 2% Precursor	23.4	B
Fragrance B	12.3	A
Fragrance B + 2% Precursor	27.3	C

- Where the same letter is shown in the “significance of differences” column there are no statistically significant differences between the relevant figures.

When assessed from 1 day dry cloth, cloth washed with Fragrance A + precursor was perceived to be significantly stronger than cloth washed with Fragrance A. Cloth washed with Fragrance B was perceived to be significantly weaker than cloth washed with Fragrance B + precursor.

d) Dry cloth 3 days

Product	Overall Perceived Intensity	Significance of Differences
Fragrance A	11.1	A
Fragrance A + 2% Precursor	22.9	C
Fragrance B	16.0	B
Fragrance B + 2% Precursor	26.1	D

Where the same letter is shown in the “significance of differences” column there are no statistically significant differences between the relevant figures.

- When assessed from 3 day dry cloth, cloth washed with Fragrance B + 2% precursor was perceived to be significantly stronger than cloth washed with any of the other products. Whereas, cloth washed with Fragrance A was perceived to be significantly weaker than cloth washed with any of the other products.

e) Dry cloth 7 days

Product	Overall Perceived Intensity	Significance of Differences
Fragrance A	14.1	A
Fragrance A + 2% Precursor	23.1	B
Fragrance B	15.6	A
Fragrance B + 2% Precursor	25.2	B

- Where the same letter is shown in the “significance of differences” column there are no statistically significant differences between the relevant figures.

When assessed from 7 day dry cloth, cloth washed with Fragrance A + 2% precursor or Fragrance B + 2% precursor were not perceived to be significantly different, but were perceived to be significantly stronger than cloth washed with Fragrance A or Fragrance B which were also not perceived to be significantly different to each other.

f) Conclusion

When assessed from wet cloth, for both Fragrance A and Fragrance B, the cloth washed with product containing the precursor was comparable in terms of strength to cloth washed with product not containing the precursor. When assessed from 1 day, 3 day and 7 day dry cloth, for both Fragrance A and Fragrance B, the cloth washed with

product containing the precursor was perceived to be significantly stronger than the same fragrance without the precursor.

Example 26: Application in all-purpose cleaner

5 a) General

As series of experiments was conducted in order to determine whether fragrance ingredients according to the present invention show intensity benefits in all purpose cleaners (APCs). The compound of Example 1 (4-(dodecylthio)-4-methylpentan-2-one) was tested with two fragrances A and B, which had different olfactive profiles. The
10 products were assessed in booths on the floor at fresh (time = 0) and after 1 hour, 2 hours and 4 hours application.

The members of a sensory analysis panel were selected on a basis of their olfactory sensory acuity and then trained for several months. Their training enabled them to identify individual odor characteristics and score their perceived intensity against given
15 standards in a consistent manner.

The testing was carried out in small booths (10 m³ booths, 21 °C, 50% RH) specifically designed. The booths were closed during testing, with the doors sealed. The APC products were diluted at 1.2% in warm water (45°C +/- 2°C). 60 mL of the diluted product was applied directly to the booth floor. It was evenly spread using a gloved
20 hand, over an area of 65 cm x 65 cm.

The system was assessed through a porthole in the door of the booth. The overall perceived intensity was assessed by the trained sensory panel using a 0-100 line scale. The dilution assessment was conducted over four sessions. The Fresh (time = 0), 1 hour and 4 hour stages were assessed by 16 panelists, thus giving 32 assessments per
25 product. The 2 hour stage was assessed by 17 panelists, thus giving 34 assessments per product.

The estimated product means are reported on the next pages, together with any statistically significant differences between products.

b) Fresh (time = 0) bloom from floor assessment

Product	Overall Perceived Intensity	Significance of Differences
Fragrance A	33.8	A
Fragrance A + 5% Precursor	33.7	A
Fragrance B	36.5	A
Fragrance B + 4% Precursor	37.8	A
Fragrance B + 8% Precursor	36.5	A

Where the same letter is shown in the “significance of differences” column there are no statistically significant differences between the relevant figures.

When the products were assessed fresh (time = 0), there was no perceived significant
5 difference between the booths containing any of the five products tested.

c) One hour bloom from floor assessment

Product	Overall Perceived Intensity	Significance of Differences
Fragrance A	28.8	A
Fragrance A + 5% Precursor	37.9	C
Fragrance B	33.1	B
Fragrance B + 4% Precursor	35.4	BC
Fragrance B + 8% Precursor	37.0	C

Where the same letter is shown in the “significance of differences” column there are no statistically significant differences between the relevant figures.

When the products were assessed after 1 hour application, booths containing
10 Fragrance B + 8% precursor or Fragrance A + 5% precursor were not perceived to be significantly different to booths containing Fragrance B + 4% precursor, but were perceived to be significantly stronger than booths containing Fragrance A or Fragrance B.

d) Two hour bloom from floor assessment

Product	Overall Perceived Intensity	Significance of Differences
Fragrance A	21.6	A
Fragrance A + 5% Precursor	29.2	B
Fragrance B	18.2	A
Fragrance B + 4% Precursor	19.5	A
Fragrance B + 8% Precursor	31.1	B

Where the same letter is shown in the "significance of differences" column there are no statistically significant differences between the relevant figures.

- When the products were assessed after 2 hours application, the booths containing
- 5 Fragrance A + 5% precursor or Fragrance B + 8% precursor, which were not perceived to be significantly different, were perceived to be significantly stronger than the booths containing Fragrance A, Fragrance B or Fragrance B + 4% precursor, which were also not perceived to be significantly different to each other.

e) Four hour bloom from floor assessment

Product	Overall Perceived Intensity	Significance of Differences
Fragrance A	20.4	B
Fragrance A + 5% Precursor	28.6	C
Fragrance B	10.8	A
Fragrance B + 4% Precursor	20.8	B
Fragrance B + 8% Precursor	27.2	C

- 10 Where the same letter is shown in the "significance of differences" column there are no statistically significant differences between the relevant figures.

- When the products were assessed after 4 hours application, the booths containing
- 15 Fragrance B + 8% precursor or Fragrance A + 5% precursor, which were not perceived to be significantly different, were perceived to be significantly stronger than booths containing Fragrance A or Fragrance B + 4% precursor, which were also not perceived to be significantly different to each other. Furthermore, booths containing Fragrance B were perceived to be significantly weaker than the booths containing any of the other four products tested.

f) Conclusion

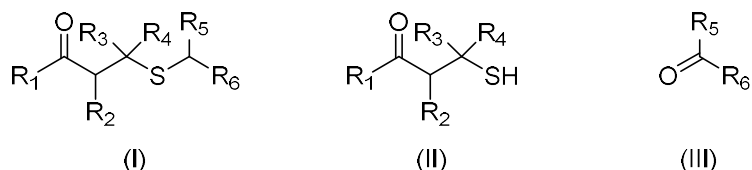
Fragrance A + 5% precursor was comparable in terms of strength to Fragrance A at fresh (time = 0), but was perceived to be significantly stronger than Fragrance A when assessed 1 hour, 2 hours and 4 hours after application.

- 5 The Fragrance B + 8% precursor was comparable in terms of strength to Fragrance B at fresh (time = 0) but was perceived to be significantly stronger than Fragrance B when assessed 1 hour, 2 hours and 4 hours after application. Whereas Fragrance B + 4% precursor was comparable in terms of strength to Fragrance B at the fresh, 1 hour and 2 hour assessments, but was perceived to be significantly stronger than Fragrance
- 10 B when assessed 4 hours after application.

Furthermore, Fragrance A + 5% precursor and Fragrance B + 8% precursor were comparable in terms of strength when assessed at all time points (0, 1, 2 and 4 hours).

Claims

1. Use of a compound of formula (I) as a precursor for generating a compound of formula (II) and/or a compound of formula (III)



5 wherein

- a) R₁ is selected from the group consisting of methyl, ethyl, n-propyl or isopropyl; R₂ is H or C₁₋₅-alkyl; R₃ is H or C₁₋₅-alkyl; and R₄ is C₁₋₆-alkyl; or
- b) R₁ and R₄ together with the carbon atoms to which they and R₂ are attached form a 5, 6 or 7 membered hydrocarbon ring; R₂ is H or C₁₋₄-alkyl; and R₃ is H or C₁₋₄-alkyl; or
- c) R₁ is H; R₂ is H; R₃ is H; and R₄ is methyl; or
- d) R₁ is H; R₂ is H; R₃ is methyl; and R₄ is methyl;

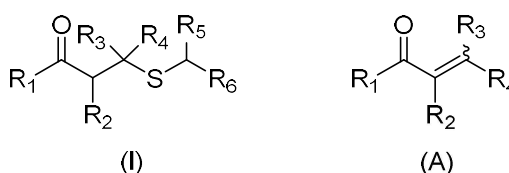
and wherein

15 R₅ is H or a residue comprising 1 to 20 carbon atoms; and R₆ is a residue comprising 6 to 20 carbon atoms, wherein R₆ is a hydrocarbon residue which does not contain any heteroatoms and is selected from alkyl and alkenyl.

2. A use according to claim 1, wherein the total combined number of carbon atoms of R₁, R₂, R₃ and R₄ is 1 to 6, preferably 1 to 5, more preferably 1 to 4, even more preferably 1 to 3.
- 20 3. A use according to one of claims 1 or 2, wherein R₁ is methyl; R₂ is H; R₃ is H; and R₄ is methyl.
4. A use according to one of claims 1 or 2, wherein R₁ is methyl; R₂ is H; R₃ is methyl; and R₄ is methyl.
5. A use according to one of claims 2 to 4, wherein R₆ is a residue comprising 7 to 16 carbon atoms, preferably 8 to 14 carbon atoms, even more preferably 9 to 13 carbon atoms.
- 25 6. A use according to claim 2, wherein the compound of formula (I) is selected from the group consisting of 3-(octylthio)butanal, 4-methyl-4-(octylthio)pentan-2-one, 3-(decylthio)butanal, 4-(decylthio)-4-methylpentan-2-one, 4-

(dodecylthio)pentan-2-one, 4-(dodecylthio)-4-methylpentan-2-one, 4-(dodecylthio)-3-methylpentan-2-one, 3-(dodecylthio)-3-methylbutanal, 3-(dodecylthio)butanal, 3-(dodecylthio)-3-methylcyclohexan-1-one, 3-(dodecylthio)-3-methylcyclopentan-1-one, 3-(tetradecylthio)butanal and 4-methyl-4-(tetradecylthio)pentan-2-one, 4-methyl-4-((6-methyloctyl)thio)pentan-2-one, 3-((3-(4-isobutyl-2-methylphenyl)propyl)thio)butanal and 4-((3-(4-isobutyl-2-methylphenyl)propyl)thio)-4-methylpentan-2-one.

7. A composition of matter comprising a compound of formula (I) and a compound of formula (A)



wherein

- a) R_1 is selected from the group consisting of methyl, ethyl, n-propyl or isopropyl; R_2 is H or C_{1-5} -alkyl; R_3 is H or C_{1-5} -alkyl; and R_4 is C_{1-6} -alkyl; or
- b) R_1 and R_4 together with the carbon atoms to which they and R_2 are attached form a 5, 6 or 7 membered hydrocarbon ring; R_2 is H or C_{1-4} -alkyl; and R_3 is H or C_{1-4} -alkyl; or
- c) R_1 is H; R_2 is H; R_3 is H; and R_4 is methyl; or
- d) R_1 is H; R_2 is H; R_3 is methyl; and R_4 is methyl;

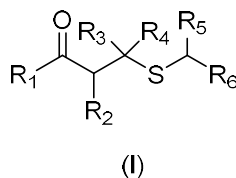
and wherein

R_5 is H or a residue comprising 1 to 20 carbon atoms; and R_6 is a residue comprising 6 to 20 carbon atoms, wherein R_6 is a hydrocarbon residue which does not contain any heteroatoms and is selected from alkyl and alkenyl;

wherein the amount of the compound of formula (A) in relation to the total amount of the compound of formula (I) and the compound of formula (A) is 0.1 to 3.0 wt.-%, preferably 0.3 to 1.2 wt.-%, even more preferably 0.6 to 1.0 wt.-%.

8. A consumer product comprising a composition of matter according to claim 7, wherein the consumer product is a personal care product, a laundry care product or a household care product.

9. A consumer product comprising a compound of formula (I)



wherein

- 5 a) R_1 is selected from the group consisting of methyl, ethyl, n-propyl and isopropyl; R_2 is H or C_{1-4} alkyl; R_3 is H or C_{1-4} alkyl; and R_4 is C_{1-4} -alkyl; or
- b) R_1 and R_4 together with the carbon atoms to which they and R_2 are attached form a 5 or 6 membered hydrocarbon ring; R_2 is H or C_{1-4} -alkyl; and R_3 is H or C_{1-4} -alkyl; or
- c) R_1 is H; R_2 is H; R_3 is H; and R_4 is methyl; or
- 10 d) R_1 is H; R_2 is H; R_3 is methyl; and R_4 is methyl;

and wherein

R_5 is H or a residue comprising 1 to 20 carbon atoms; and R_6 is a residue comprising 6 to 20 carbon atoms, wherein R_6 is a hydrocarbon residue which does not contain any heteroatoms and is selected from alkyl and alkenyl; and

15 wherein

the total combined number of carbon atoms of R_1 , R_2 , R_3 and R_4 is 1 to 4, preferably 1 to 3,

wherein the consumer product is a personal care product, a laundry care product or a household care product.

- 20 10. A consumer product according to claim 9, wherein the concentration of the compound of formula (I) is 0.1 wt.-% to 10 wt.-%, preferably 0.2 wt.-% to 5 wt.-%, even more preferably 0.5 wt.-% to 3 wt.-%.