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**Application of Mesoporous Molecular Sieves as
Selective Smoke Filtration Additives**

by

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CROSS-REFERENCE TO RELATED APPLICATIONS

This international patent application claims Paris Convention priority to and benefit
15 from, currently pending, U.S. Patent Application serial number 10/860,775, filed on 03 June
2004.

**STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR
DEVELOPMENT**

Not applicable.

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**REFERENCE TO A "SEQUENTIAL LISTING," A TABLE, OR A COMPUTER
PROGRAM LISTING APPENDIX SUBMITTED ON A COMPACT DISC**

Not applicable.

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BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a smoking article having a filter element and/or
smokable material containing a highly structured mesoporous molecular sieve, and more
specifically, a smoking article having a filter element and/or smokable material containing a
30 highly porous amorphous silica (hereinafter referred to as "MCM-41"), as the highly
structured mesoporous molecular sieve for filtering vapor phase constituents in mainstream
smoke.

2. Description of the Related Art

Typical smoking articles, such as cigarettes, have a cylindrical filter element axially aligned with a cylindrical tobacco-filled rod. The filter element, and even the tobacco-filled
5 rod, incorporate various materials that work to remove particular components from the mainstream smoke. Often, these materials are non-selective, thereby removing desirable components from the mainstream smoke and resulting in an undesirable taste.

Certain cigarettes have filter elements which incorporate materials such as carbon. Exemplary cigarettes and filters are described in U.S. Patent Pub. No. 2003/0159703, to
10 Yang, et al., and U.S. Patent Pub. No. 2003/0154993, to Paine, III et al. Generally, surface area is inversely proportional to carbon particle size. If the particle size is too large, there may be insufficient surface area to accomplish the desired filtration. This factor must be taken into careful consideration when selecting a particular carbon particle size. Also, filter elements which incorporate carbon often yield a metallic flavor during smoking. Carbon is
15 often impregnated with a flavorant in an attempt to camouflage the metallic flavor and may actually block the pores, an impediment to filtration, and finding a preferred flavorant loading percentage is difficult and inefficient. Furthermore, filter elements which incorporate carbon vary in proportion of micropores to mesopores, where the term "microporous" generally refers to such materials having pore sizes of about 20Å or less, while the term "mesoporous"
20 generally refers to such materials with pore sizes of about 20-500Å. Uniform pore size distribution is more favorable. By having a more uniform pore size distribution, more of the porosity can be assured to be in the mesoporous range (2-50nm), which is more effective at filtering smoke than microporous materials. A variety of pore sizes is more likely to filter a variety of compounds, and filters for specific analytes are more desirable.

A smoking article with a filter element capable of filtering vapor phase components that is efficient to produce and does not yield a metallic flavor is desired. Also, a filter element with a mesoporous molecular sieve that has uniform pore size is desired.

SUMMARY OF THE INVENTION

5 In view of known deficiencies associated with earlier smoking article filter elements, a smoking article with a mesoporous molecular sieve to filter vapor phase constituents from mainstream tobacco smoke is provided.

It has been found that a family of highly ordered mesoporous molecular sieves, manufactured by the Mobil Corporation and identified as M41S, are useful in smoking article
10 filter elements. M41S materials are non-crystalline surfactant templated silica having a narrow pore size distribution. MCM-41 is a highly porous surfactant templated silica gel belonging to the M41S family, and contains a highly organized hexagonal array of uniform pores with controllable diameters from about 15 Å to about 100 Å. The term “hexagonal” encompasses materials that exhibit mathematically perfect hexagonal symmetry and materials
15 with significant observable deviations from perfection. MCM refers to Mobil Composition of Matter or Mobil Crystalline Material, and was developed as a catalyst substrate by Mobil.

The surface chemistry of siliceous MCM-41 is comprised of silanol groups (SiOH), and may be synthesized using cetyltrimethylammonium chloride (CTACl), H₂O, Na₂O, and SiO₂. The formed MCM-41 may be utilized as a mesoporous molecular sieve in smoking
20 articles. MCM-41 has a highly condensed surface with less SiOH groups than silica, and its uniqueness is in the shape it adopts by forming around a template which is subsequently removed. The use of mesopores as an absorbent is taught by U.S. Patent No. 5,580,370, to Kuma, et al. Furthermore, MCM-41 has a large surface area, where the BET surface area is approximately 1000 m²/g, and thus has a high sorption capacity. (“BET” refers to Brunaur,
25 Emmett, and Teller, three scientists who optimized the theory for measuring surface areas.)

MCM-41 is effective for reducing levels of alcohols, aldehydes, ketones, nitriles, and naphthalene.

It is an object of the present invention to provide a smoking article with a filter element having a mesoporous molecular sieve, MCM-41. A preferred smoking article is a cigarette with MCM-41 disposed within the filter element.

It is another object to provide a smokable material in a smokable rod of the smoking article having the mesoporous molecular sieve, MCM-41. A preferred smoking article is a cigarette and a preferred smokable material is tobacco. In this embodiment, MCM-41 is disposed within the smokable material in the rod.

It is yet another object to provide the filter element and the smokable material in the smokable rod of the smoking article both having the mesoporous molecular sieve, MCM-41. In this embodiment, MCM-41 is disposed within the filter element and throughout the smokable material in the rod.

It is still yet a further object to provide either or both the filter element or the smokable material in the smokable rod of the smoking article having the mesoporous molecular sieve, MCM-41, in combination with charcoal, an ion-exchange resin, or both.

It is still yet another object to provide either or both the filter element or the smokable material in the smokable rod of the smoking article having an impregnated mesoporous molecular sieve, MCM-41. MCM-41 can be impregnated with copper oxide for greater HCN and H₂S reduction.

BRIEF DESCRIPTION OF THE DRAWINGS

The aspects and advantages of the present invention will be better understood when the detailed description of the preferred embodiment is taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a graph showing total particulate matter normalized percentage reductions of various vapor phase analytes when utilizing MCM-41 in a cigarette filter.

FIG. 2 is a graph showing total particulate matter normalized percentage reductions of mainstream smoke carbonyls.

5 FIG. 3 is a graph showing selected vapor phase analytes percentage reductions of MCM-41 and Sorbite.

FIG. 4 is a graph showing mainstream smoke carbonyl percentage reductions of MCM-41 and Sorbite.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

10 While this invention is susceptible of embodiments in many different forms, there are shown in the figures and will herein be described in detail, preferred embodiments of the invention with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention, and is not intended to limit the broad aspects of the invention to the embodiments illustrated.

15 The present invention provides for an article for smoking with a mesoporous molecular sieve, MCM-41, to filter vapor phase constituents from mainstream tobacco smoke. Vapor phase constituents to be filtered contact MCM-41 and are retained within the pores, thereby providing a separation of the undesirable constituents from the remainder of the vapor. MCM-41 is typically a black or white granular material with a density of
20 $\approx 0.3\text{g/cm}^3$ and a BET surface area of $\approx 1000\text{m}^2/\text{g}$. Although pore wall thickness may vary, MCM-41 typically has a uniform pore diameter of $\approx 3.7\text{nm}$, when cetyltrimethyl ammonium bromide is used.

The following examples are given for illustrative purposes only and are not to be deemed as limitative of the scope of the invention.

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Example 1

MCM-41 ADSORPTIVE PROPERTIES

To evaluate the adsorptive properties of MCM-41, MCM-41 was tested in hand-made cavity filters and compared to semolina (inert flour granules used to simulate a granule-filled
5 cavity). Hand-made cavity filters can be made by first removing the cellulose acetate (CA) filter of a cigarette. Shortened segments of CA on the tobacco and mouth end of the filter create a cavity to hold the granular material.

The MCM-41 sample sets were prepared according to usual synthesis procedure, except for minor modifications. MCM-41 was developed by Exxon/Mobil, but sample sets
10 for experiment purposes were developed in the laboratory. Water, the surfactant cetyltrimethyl ammonium bromide (CTAB), and tetraethyl orthosilicate (TEOS) were mixed, in order, in a 250mL glass bottle until a cloudy white suspension was achieved. CTAB and TEOS were combined with a surfactant:silica mole ratio of 1:2. The solution's surfactant concentration, by total weight, equaled 25%. Concentrated sulfuric acid was added drop wise
15 until the mixture changed to a clear liquid. The solution was stirred at approximately 400 rpm for .5 hours, and then placed under static autogenous conditions (121°C, 18psi) for 1 hour. The resulting gel was removed from the autoclave and allowed to cool before being washed thoroughly with deionized water. The washed material was heated at 570°C for six to eight hours in air, resulting in a porous material with a BET surface area of $\approx 1300\text{m}^2/\text{g}$.

20 Sample sets of cigarettes containing 50mg of a granular additive in a hand-made cavity filter were prepared using either MCM-41 synthesized as described above or semolina. Each sample set was pressure drop selected to decrease smoke delivery variances. Samples were conditioned (65% relative humidity and 75°C for 48 hours) and analyzed for total measured vapor phase (TMVP), mainstream smoke (MSS) HCN, and MSS carbonyl
25 deliveries.

Cigarettes with cavities containing 50mg of either semolina or MCM-41 were analyzed for TMVP smoke deliveries. TABLE A shows the results for selected vapor phase smoke compounds, comparing semolina with MCM-41:

TABLE A. Vapor Phase Smoke Analysis Data ($\mu\text{g}/\text{cig}$)

Analyte	Semolina (50 mg/tip)	MCM-41 (50 mg/tip)
Hydrogen sulfide	21.0	22.3
Hydrogen cyanide	76.4	68.1
Methanol	79.5	30.4
Acetaldehyde	647.0	536.1
Vinyl chloride	0.0	0.0
1,3-Butadiene	55.6	54.2
Acetonitrile	69.6	33.6
Propylene oxide	2.9	1.8
Acrolein	82.0	45.8
Furan	27.9	22.4
Propionaldehyde	62.7	33.3
Acetone	228.5	91.1
Acrylonitrile	10.3	6.0
Carbon disulfide	3.8	4.0
Isoprene	396.4	371.5
Propionitrile	11.6	4.5
i-Butyraldehyde	18.1	10.0
Methacrylonitrile	2.2	1.2
n-Butyraldehyde	6.5	3.5
Methyl ethyl ketone	48.3	15.0
Crotonaldehyde	12.6	6.8
Benzene	35.1	33.3
Toluene	35.1	28.1
Styrene	3.0	1.3
Total TMVP	1936.1	1424.3
TPM (mg/cig)	13.1	12.7
TMVP/TPM ($\mu\text{g}/\text{mg}$)	147.8	112.1

MCM-41 showed a greater reduction of analytes in the TMVP/TPM of $112.1\mu\text{g}/\text{mg}$.

TMVP/TPM was higher with semolina ($147.8\mu\text{g}/\text{mg}$). FIG. 1 shows computed total particulate matter (TPM) normalized percentage reductions for various vapor phase

constituents. These data suggest that the MCM-41 sample exhibited high filtration efficiencies for nitriles, ketones, and aldehydes when compared to the semolina control.

Large percentage reductions were shown for the analytes Propionitrile (58%), Methanol (59%), Methyl Ethyl Ketone (66%), and Propionaldehyde (43%). Overall, TMVP deliveries were reduced by 24% when utilizing MCM-41.

Mainstream smoke (MSS) carbonyl deliveries for semolina and MCM-41 are

5 compared in TABLE B:

TABLE B. MSS Carbonyl Deliveries ($\mu\text{g}/\text{cig}$)

Analyte	Semolina (50 mg/tip)	MCM-41 (50 mg/tip)
Acetaldehyde	701.7	444.8
Acetone	276.4	72.4
Acrolein	115.1	46.2
Butanone	84.6	17.9
Butyraldehyde	45.8	14.1
Crotonaldehyde	28.0	10.9
Formaldehyde	55.7	34.4
Propionaldehyde	58.2	24.5
Total (μg)	1366.0	664.0
TPM (mg/cig)	13.1	12.7
Total/TPM ($\mu\text{g}/\text{mg}$)	104.3	52.3

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MCM-41 yielded less carbonyl in the mainstream smoke delivery than did semolina:

52.3 $\mu\text{g}/\text{mg}$ compared with 104.3 $\mu\text{g}/\text{mg}$, respectively. TPM normalized percentage reduction for mainstream smoke carbonyls is shown in FIG. 2. The data indicates that the MCM-41 sample displayed an increased affinity for MSS carbonyls versus the semolina control. The

15 MCM-41 sample reduced mainstream smoke carbonyl deliveries by a total of 49% compared to the semolina sample. MCM-41 reductions above 50% were calculated, versus the control, for the analytes acrolein, acetone, butanone, and butyraldehyde. Measured formaldehyde deliveries, when using MCM-41, showed a 34% reduction versus semolina.

TABLE C shows a summary of mean polycyclic aromatic hydrocarbon (PAH) deliveries in particulate phase smoke:

TABLE C. The Mean Levels of PAHs for the Cigarette Samples

	Semolina	MCM-41
Naphthalene	365.6	284.5
Fluorene	127.2	134.9
Phenanthrene	103.4	113.7
Anthracene	40.3	43.6
Fluoranthene	58.7	61.5
Pyrene	38.4	39.1
Benzofluorene	30.3	32.0
Benzantracene	16.8	17.2
Chrysene	17.2	18.2
Benzo[fluoranthene]	7.0	7.3
Benzo[e]pyrene	3.7	3.8
Benzo[a]pyrene (BAP)	5.8	6.1
Perylene	0.6	0.7
Dibenzanthracene	0.2	0.2
Benzo[perylene]	1.1	1.2
Total PAH (ng/cig)	816.4	763.9
TPM (mg/cig)	11.3	11.8
Puff Number	6.9	6.8
PAH per TPM (ng/mg)	72.0	64.6
BAP per TPM (ng/mg)	0.52	0.51

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When comparing the semolina with MCM-41, total particulate matter (TPM) normalized results suggest naphthalene deliveries were reduced by $\approx 29\%$. This effect may be due to the fact that naphthalene is the smallest and most volatile of the PAHs measured, demonstrating MCM-41's high affinity for small and volatile compounds. All other PAH compounds analyzed failed to show an appreciable affinity for the MCM-41 sample versus the control.

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To summarize, the MCM-41 samples were found to be an effective adsorbent for select constituents found in mainstream smoke. Significant reductions were observed for nitrile, aldehyde, and ketone deliveries. In addition, PAH deliveries indicate reduction for naphthalene. MCM-41 has an affinity for molecules that form strong intermolecular bonds,

and therefore, no reductions were observed for the analytes 1,3-butadiene, isoprene, furan, and benzene. The MCM-41 samples exhibited high filtration efficiencies for nitriles, aldehydes, and ketones when compared to the semolina control. In addition, MCM-41 displayed selectivity for naphthalene.

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Example 2

MCM-41 IN COMPARISON TO SORBITE AS A CIGARETTE FILTER ADDITIVE

To evaluate the filtration efficiency of MCM-41, MCM-41 and Sorbite, a coal-based activated carbon derived from semi-anthracite coal, available from Calgon Carbons, were placed in hand-made cavity filtered cigarettes, the properties of which are explained above, and the filtration efficiencies of both were compared. Semolina was utilized as a control. The highly porous nature of MCM-41 invited the comparison to activated carbons, such as Sorbite. The MCM-41 samples were prepared according to the above-stated method. Sorbite was used without modification.

Three sample sets were prepared with hand-made cavity filtered cigarettes. TABLE D lists the filter additives and loadings for each sample:

TABLE D. Loading Amounts for Filter Components

Filter Components	Loading (mg)
MCM-41/Semolina	50/50
Sorbite/Semolina	50/50
Semolina Control	100

The samples were pressure drop selected to diminish variances in aerosol deliveries. After conditioning, the samples were analyzed for total measured vapor phase (TMVP), polycyclic aromatic hydrocarbon (PAH), and mainstream smoke carbonyl (MSS carbonyl) deliveries.

All three samples were analyzed for TMVP. TABLE E lists vapor phase deliveries for each sample:

TABLE E. Vapor Phase Smoke Analysis Data ($\mu\text{g}/\text{cig}$)

	Semolina	Sorbite/Semolina	MCM-41/Semolina
1,3-Butadiene	69.8	69.8	69.7
Acetaldehyde	627.1	636.2	541.9
Acetone	294.7	216.5	120.9
Acetonitrile	84.2	69.6	45.2
Acrolein	75.9	50.6	43.4
Acrylonitrile	13.3	10.0	8.7
Benzene	58.9	31.6	41.2
Carbon Disulfide	4.1	3.9	3.9
Crotonaldehyde	21.6	6.3	8.3
Furan	41.4	39.1	38.9
Hydrogen Cyanide	78.0	73.3	70.7
Hydrogen Sulfide	20.0	15.1	19.9
Isoprene	551.4	426.2	473.7
Methacrylonitrile	2.5	1.5	1.3
Methanol	80.9	72.3	34.9
Methyl Ethyl Ketone	68.4	32.0	17.1
Propionaldehyde	58.2	45.7	39.4
Propionitrile	13.6	8.1	5.2
Propylene Oxide	3.8	3.8	3.0
Styrene	5.8	2.5	3.6
Toluene	62.7	23.8	35.7
Vinyl Chloride	BQL	BQL	BQL
I-Butyraldehyde	28.7	21.0	18.2
N-Butyraldehyde	8.7	5.3	4.4
TMVP	2273.1	1863.7	1648.7
TPM	12.6	12.8	12.5
TMVP/TPM	180.4	145.6	131.9

- 5 A direct comparison of the vapor phase data for MCM-41 and Sorbite reveals that, while activated carbons are a good general adsorbent for a broad range of analytes, MCM-41 is selective for the more polar analytes such as nitriles, aldehydes, ketones, and alcohols. This affinity for polar molecules can be explained by their strong intermolecular bonding with pendant hydroxide groups on the surface of the silica, and FIG. 3 displays the selectivity of
- 10 MCM-41.

All three samples were also analyzed for mainstream smoke carbonyls with the deliveries listed in TABLE F:

TABLE F. MSS Carbonyl Deliveries ($\mu\text{g}/\text{cig}$)

	Semolina	Sorbite/Sem*	MCM41/Sem*
Acetaldehyde	641.5	561.2	539.8
Acetone	256.7	164.2	104.9
Acrolein	106.7	64.4	67.4
Butanone	74.7	33.0	24.8
Butyraldehyde	40.8	19.8	18.5
Crotonaldehyde	27.2	16.7	11.6
Formaldehyde	51.8	43.6	40.1
Propionaldehyde	53.9	33.6	35.0
Total Carbonyls	1253.3	936.6	842.0
Total Carbonyls/TPM	99.5	73.2	67.4

*Sem= Semolina

TABLE F shows mainstream smoke carbonyl deliveries comparing semolina, Sorbite/semolina, and MCM-41/semolina. MCM-41 delivered 842.0 $\mu\text{g}/\text{cigarette}$ total carbonyls, while Sorbite delivered more carbonyls: 936.6 $\mu\text{g}/\text{cigarette}$. FIG. 4 shows normalized percentage reductions for mainstream smoke carbonyls of MCM-41 and Sorbite.

These results were consistent with the results of the vapor phase analyses. Reductions observed for the surfactant templated silica were (at a minimum) comparable to reductions for the Sorbite samples. A few analytes, such as acetone and crotonaldehyde, had greater reductions.

Deliveries of polycyclic aromatic hydrocarbons (PAHs) were measured because of known reductions in naphthalene for samples containing MCM-41. TABLE G shows a complete list of PAH test results:

TABLE G. Polycyclic Aromatic Hydrocarbons (PAH) Analysis Data ($\mu\text{g}/\text{cig}$)

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PAHS - FTC	Semolina	Sorbite/Sem	MCM41/Sem
Anthracene	40.8	41.4	42.1
Benzantracene	16.4	16.9	17.2
Benzo[a]pyrene	6.2	6.2	6.2
Benzo[e]pyrene	4.4	4.6	4.5
Benzo[fluoranthene	7.4	7.5	7.4
Benzo[fluorene	28.5	28.7	30.6
Benzo[perylene	1.2	1.2	1.2
Chrysene	18.8	19.0	19.4
Dibenzanthracene	0.2	0.2	0.2
Fluoranthene	47.0	45.8	49.4
Fluorene	130.0	126.0	131.5
Naphthalene	453.0	198.0	271.0
Perylene	0.6	0.6	0.6
Phenanthrene	111.0	110.5	111.0
Pyrene	39.5	39.0	39.9
PAHS TPM	13.3	12.7	13.2
Total PAH	904.9	645.3	732.0
Total PAH / TPM	68.3	50.7	55.4

Total particulate matter (TPM) normalized reductions of naphthalene versus a semolina control for MCM-41 was $\approx 40\%$, and for Sorbite was $\approx 54\%$. No other reductions in PAHs were observed. Although naphthalene is the smallest and most volatile of the PAH analytes measured, reductions in naphthalene are presumably due to its volatility and not its size. The pore diameter of MCM-41 is large relative to anthracene, the next smallest analyte measured, in which no reductions were observed. These numbers reflect the capacity of Sorbite to adsorb non-polar molecules.

To summarize, the MCM-41 sample was found to be more selective for polar smoke constituents and outperformed the Sorbite for the removal of nitriles, ketones, alcohols, and aldehydes. The Sorbite sample was more selective for non-polar smoke constituents such as benzene, toluene, styrene, isoprene, and naphthalene. MCM-41 can compliment Sorbite and other additives, such as an ion-exchange resin, as a co-additive.

EXAMPLE 3

COPPER OXIDE IMPREGNATED MCM-41

A sample of MCM-41 was prepared using the process as described in EXAMPLE 1.

Additionally, copper nitrate was introduced into the MCM-41 reaction solution with a

5 concentration of 3% by weight. The resulting gel was calcined at 400°C, forming a copper oxide impregnated MCM-41 having the same high surface area and vapor phase capacity as pure MCM-41, but with the added ability to reduce hydrogen cyanide and hydrogen sulfide. Compared to the semolina control as previously described, copper oxide impregnated MCM-41 showed a 56% reduction in HCN and a 35% reduction in H₂S.

10 The foregoing detailed description is given primarily for clearness of understanding and no unnecessary limitations are to be understood therefrom, for modifications will become obvious to those skilled in the art upon reading this disclosure, and may be made without departing from the spirit of the invention and scope of the appended claims.

What is claimed is:

1. A smoking article, comprising:
a smokable material circumscribed with a wrapping material to form a smokable rod; and,
an axially aligned filter element, wherein said filter element includes a mesoporous molecular sieve.
2. The article of claim 1, wherein said mesoporous molecular sieve is disposed within said filter element.
3. The article of claim 1, wherein said filter element includes a plurality of filter cavities, wherein one or more of said filter cavities includes a mesoporous molecular sieve.
4. The article of claim 1, wherein said mesoporous molecular sieve is MCM-41.
5. The article of claim 1, wherein said mesoporous molecular sieve is a surfactant templated silica gel having an organized hexagonal array of uniform pores.
6. The article of claim 5, wherein said uniform pores have diameters of from about 15Å to about 100Å.
7. A smoking article, comprising:
a smokable material circumscribed with a wrapping material to form a smokable rod; and,
an axially aligned filter element, wherein said smokable material includes a mesoporous molecular sieve, said mesoporous molecular sieve being disposed within said smokable rod.
8. The article of claim 7, wherein said wrapping material is coated with said mesoporous molecular sieve.
9. The article of claim 7, wherein said mesoporous molecular sieve is MCM-41.
10. The article of claim 7, wherein said mesoporous molecular sieve is a surfactant templated silica gel having an organized hexagonal array of uniform pores.

11. The article of claim 10, wherein said uniform pores have diameters of from about 15Å to about 100Å.
12. A smoking article, comprising:
a smokable material circumscribed with a wrapping material to form a smokable rod; and,
an axially aligned filter element, wherein said smokable material, said wrapping material, and said filter element include a mesoporous molecular sieve, said mesoporous molecular sieve being disposed within said smokable material and said filter element and coated on said wrapping material.
13. The article of claim 12, wherein said mesoporous molecular sieve is MCM-41.
14. The article of claim 12, wherein said mesoporous molecular sieve is a surfactant templated silica gel having an organized hexagonal array of uniform pores
15. The article of claim 14, wherein said uniform pores have diameters of from about 15Å to about 100Å.
16. A cigarette, comprising:
a tobacco rod with a filter element attached thereto; and
a mesoporous molecular sieve.
17. The cigarette of claim 16, wherein said mesoporous molecular sieve is disposed within said filter element.
18. The cigarette of claim 16, wherein said filter element includes a plurality of filter cavities.
19. The cigarette of claim 18, wherein one or more of said filter cavities includes said mesoporous molecular sieve.

20. The cigarette of claim 16, wherein said filter element is attached in axial alignment with a tobacco-filled smokable rod, said smokable rod including said mesoporous molecular sieve disposed therein.
21. The cigarette of claim 20, wherein said filter element and said smokable rod are circumscribed with a wrapping paper, said wrapping paper coated with said mesoporous molecular sieve.
22. The cigarette of claim 16, wherein said mesoporous molecular sieve is MCM-41.
23. The cigarette of claim 16, wherein said mesoporous molecular sieve is a surfactant templated silica gel having an organized hexagonal array of uniform pores.
24. The cigarette of claim 23, wherein said uniform pores have diameters from about 15Å to about 100Å.
25. A smoking article, comprising:
a smokable material circumscribed with a wrapping material to form a smokable rod; and,
an axially aligned filter element,
wherein said smoking article includes a mesoporous molecular sieve and a plurality of additives.
26. The article of claim 25, wherein said mesoporous molecular sieve and said additives are disposed within said smokable material.
27. The article of claim 25, wherein said mesoporous molecular sieve and said additives are disposed within said filter element.
28. The article of claim 25, wherein said mesoporous molecular sieve and said additives are disposed within said smokable material and said filter element.

29. The article of claim 25, wherein said filter element includes a plurality of filter cavities, and wherein one or more of said filter cavities includes said mesoporous molecular sieve and said additives.
30. The article of claim 25, wherein said mesoporous molecular sieve is MCM-41.
31. The article of claim 25, wherein said mesoporous molecular sieve is a surfactant templated silica gel having an organized array of uniform pores.
32. The article of claim 31, wherein said uniform pores have diameters from about 15Å to about 100Å.
33. The article of claim 25, wherein one of said additives is an activated carbon.
34. The article of claim 33, wherein said activated carbon is a Sorbite.
35. The article of claim 25, wherein one of said additives is an ion-exchange resin.
36. A smoking article, comprising:
a smokable material circumscribed with a wrapping material to form a smokable rod; and,
an axially aligned filter element, wherein said smoking article includes a mesoporous molecular sieve impregnated with copper oxide.
37. The article of claim 36, wherein said mesoporous molecular sieve impregnated with copper oxide is disposed within said smokable material.
38. The article of claim 36, wherein said filter element includes said mesoporous molecular sieve impregnated with copper oxide disposed therein.
39. The article of claim 36, wherein said filter element is comprised of a plurality of filter cavities, and wherein one or more of said filter cavities includes said mesoporous molecular sieve impregnated with copper oxide.
40. The article of claim 36, wherein said mesoporous molecular sieve impregnated with copper oxide is disposed within said smokable material and said filter element.

41. The article of claim 36, wherein said mesoporous molecular sieve is MCM-41.
42. The article of claim 36, wherein said mesoporous molecular sieve is a surfactant templated silica gel having an organized array of uniform pores.
43. The article of claim 42, wherein said uniform pores have diameters from about 15Å to about 100Å.
44. A filter for a smoking article, comprising:
a filter element with a mesoporous molecular sieve; and
a plurality of additives disposed within said filter element.
45. The filter of claim 44, wherein said mesoporous molecular sieve and said additives are disposed within said filter element.
46. The filter of claim of 44, including a plurality of filter cavities.
47. The filter of claim 46, wherein at least one of said filter cavities includes a mesoporous molecular sieve and at least one of said filter cavities includes said additives.
48. The filter of claim 44, wherein said mesoporous molecular sieve is MCM-41.
49. The filter of claim 44, wherein said mesoporous molecular sieve is a surfactant templated silica gel having an organized array of uniform pores.
50. The filter of claim 49, wherein said uniform pores have diameters from about 15Å to about 100Å
51. The filter of claim 44, wherein one of said additives is an activated carbon.
52. The filter of claim 51, wherein said activated carbon is a Sorbite.
53. The filter of claim 44, wherein one of said additives is an ion-exchange resin.
54. The filter of claim 44, wherein said mesoporous molecular sieve is impregnated with copper oxide.