alcohol sulfation and carbon-carbon double bond sulfonation may compete, with most of the reaction product resulting from sulfation, although the nature of the sulfonated by-products is generally not well understood (see, e.g., U.S. Pat. No. 5,446,188). Because of the competing side reactions, unsaturated alcohols are usually avoided when the goal is to make an alcohol sulfate or ether sulfate.

In sum, despite the known value of longer-chain fatty alcohols and shorter-chain saturated fatty alcohols for making ethoxylates, sulfates, and ether sulfates for use as surfactants, it is less clear what value the surfactants would have if they were made using shorter-chain unsaturated (e.g., $C_{10}$-$C_{12}$) fatty alcohols. The availability of undecylenic acid and undecylenic alcohol as feedstocks invites further investigation.

## SUMMARY ~~OF THE INVENTION~~

In one aspect, the ~~invention~~ present disclosure relates to a surfactant composition comprising water and 1 to 99 wt.% of a surfactant. The surfactant comprises an alkoxylate, a sulfate or an ether sulfate of a $C_{10}$-$C_{12}$ monounsaturated alcohol. In particular ~~aspects~~embodiments, the alkoxylate, sulfate, or ether sulfate derives from readily available undecylenic acid or undecylenic alcohol. In other ~~aspects~~embodiments, the surfactant comprises 40 to 60 wt.% of a monounsaturated $C_{10}$-$C_{12}$ primary alcohol sulfate and 40 to 60 wt.% of a secondary hydroxyalkyl $C_{10}$-$C_{12}$ primary alcohol sulfate.

We found that alkoxylate, sulfate, and ether sulfate surfactants made from $C_{10}$-$C_{12}$ monounsaturated alcohols offer unexpected advantages. Compared with their saturated analogs, the monounsaturated alkoxylates, sulfates, and ether sulfates are less irritating, making them valuable for personal care, laundry, cleaners, and other household applications. Additional advantages are apparent from microscopy studies, which indicate that the monounsaturated alkoxylates, sulfates, and ether sulfates have favorable phase behavior over a wide range of actives levels. This enables formulation of products with greater compaction, allowing formulators to ship more product and less water in a given container. When combined with cationic surfactants, the alkoxylates, sulfates and ether sulfates exhibit considerable synergy, and they have improved solubility compared with their saturated analogs.

The surfactants will be useful in many applications and industries, including personal care, laundry and cleaning, emulsion polymerization, agricultural products, oilfield applications, and specialty foams.

In another aspect, there is provided a water-soluble herbicide comprising the composition as disclosed above.

In another aspect, there is provided a hard-surface cleaner comprising the composition as disclosed above.

In another aspect, there is provided a glass cleaner comprising the composition as disclosed above.

In another aspect, there is provided an agricultural dispersant comprising the composition as disclosed above.

In another aspect, there is provided a synergistic surfactant blend comprising a cationic surfactant and the composition as disclosed above.

In another aspect, there is provided a process which comprises reacting a composition comprising a monounsaturated $C_{10}$-$C_{12}$ alcohol with an alkoxylating agent, a sulfating agent, or an alkoxylating agent followed by a sulfating agent to make, respectively, an alkoxylate, a sulfate, or an ether sulfate.

In another aspect, there is provided a process for making an internally monounsaturated $C_{10}$-$C_{12}$ alcohol sulfate or ether sulfate, the process comprising reacting a terminally monounsaturated $C_{10}$-$C_{12}$ alcohol or alkoxylate with sulfur trioxide in a falling-film reactor, followed by neutralization.