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CO_2-responsive materials as protective coatings

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Current water-based coatings are formulated as aqueous suspensions of microscopic water-insoluble polymer particles. [1] These particles can coalesce into a continuous coating as water evaporates. [2] Possible challenges with these water-based heterogeneous formulations include soft coatings, matte finishes, and problems with film formation at low temperatures.

Conversely, solvent-based coatings do not have these issues since they are formulated as homogeneous solutions of polymers dissolved in an organic solvent. [1] This provides protective coatings that are much harder, have high gloss and are useable under a wide range of conditions, for a wide variety of applications.

Increasing environmental awareness, regulations and health concerns with the volatile organic compounds emitted from the use of solvent-based coatings have resulted in a desire for water-based coatings that have similar or better performance than solvent-based paints. [3, 4] We have developed a new approach to doing this using a polymer that can be selectively water-soluble when stored, but water-insoluble when applied, thereby retaining the most advantageous properties of each type of coating.

In our work, we use a "CO_2-responsive" polymeric amine is capable of forming a homogeneous solution in carbonated water but gives a water-insoluble coating when cast, even at low temperatures. Water evaporation and CO_2 evolution provides a high-gloss hydrophobic coating. Further development of these materials serves may yield replacements for solvent-based coatings with the associated benefits of a water-based coating.

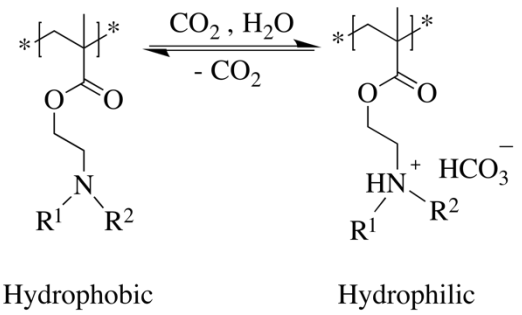

Figure 1. CO_2-responsive polymeric amines are hydrophobic in the absence of CO_2 and water but are hydrophilic in the presence of CO_2 and water.

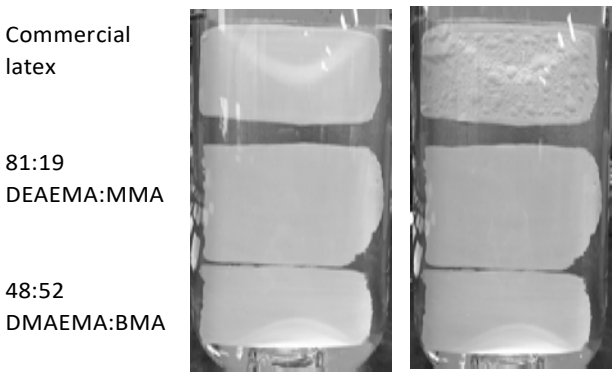

Figure 2. The stability of dried CO_2-responsive materials and commercially water-based latex after immersion in water for one week.

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