Dynamic Contact Angle Measurements of Superhydrophobicity in Dip-Coated Face Masks to Minimize Exposure to COVID-19 Sized Nanoparticles

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Superhydrophobicity, a high degree of water repellency, is characterized by a large static contact angle between a liquid bead and a surface. Last year's project successfully treated fabrics with experimental hydrophobic coatings to repel household spills using static contact angle measurements. This year, the focus was on the real-life applications of these experimental coatings to face masks, extensively testing their ability to repel a COVID-19 sized particle suspension in synthetic mucus, emulating an infected breath (both in the velocity and concentration of particles), using dynamic contact angle measurements. These measurements were made under non-equilibrium conditions as the droplet grows and shrinks by quantifying a contact angle hysteresis. The experiments utilized two different approaches to record the dynamic contact angle: measuring the front and back angle of a droplet as it rolls off the surface and measuring the advancing and receding contact angle by expanding and decreasing the droplet size. These measurements, images, and videos produced showed that both coated masks and fabrics exhibit effective dynamic hydrophobic properties. The best results were obtained with polyurethane-based coatings for the fabrics with water and silane-based coatings for the application testing to face masks - both with 0.2% nanosilica, with reasons for these differences presented by analyzing the physics involved. These coated hydrophobic masks can potentially minimize exposure time to COVID-19 causing the virus to roll off the face mask surface, rather than wetting it, thus protecting the wearer. This approach can also be extended to minimizing exposure to allergens and other harmful pollutants, potentially enhancing lives.

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