THE USE OF BORON NITRIDE NANOTUBES IN SPRAYABLE PRECERAMIC POLYMER COATINGS

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INTRODUCTION

Existing research has shown that preceramic polymers can be cured with UV light to form polymer-derived ceramic materials. Upon light processing, the non-nanotube boron nitride is removed from the system, leaving only an ultra-lightweight complex which can add structure to materials without adding significant weight. Layer-by-layer spraying techniques have been found to have high efficacy in applying flat layers of silver nanowires to surfaces while maximizing the polarization efficacy. The purpose of this project is to develop a formula for a preceramic polymer solution with boron nitride nanotubes that can be used in airbrushing and other thin-layer application mechanisms. This solution will then be pyrolyzed into a polymer-derived ceramic with BNNTs dispersed throughout it to add structure and aid in the management of heat flow.

METHODS

Solution: combine 1 gram boron nitride nanotubes (BNNT) for every 10 grams of SMP-10 in a beaker. In a graduated cylinder, measure in mL an equal amount of toluene as the BNNT. Pour the toluene over the BNNT/SMP-10 mixture. Sonicate the mixture until the BNNT is homogenously suspended.
Substrate: cover a hotplate with a layer of foil, and then to tape a glass slide to the foil cover using a heat-resistant tape. Heat the glass to approximately 100ºC. When the substrate is heated, pour the suspension into an airbrush, and spray the coating onto the substrate, ensuring that the heating plate is still on. Let it dry completely between layers. Add layers as needed

RESULTS

No significant data has been collected yet that speaks to the effectiveness of the solution. Significant changes have been noticed when the solution is sprayed onto a warmed substrate (via heating plate) as opposed to a room temperature substrate. Figure 1 shows the fully dried comparison of 3 layers of solution with and without a heated substrate. When the solution was applied to the heated glass, it dried almost immediately. However, with the room temperature glass, it took about 7 minutes for each layer to dry.

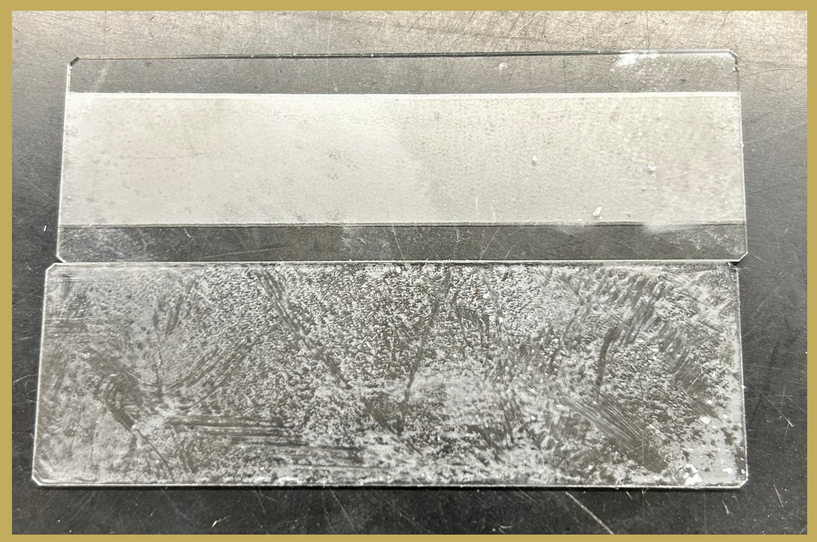

Figure 1
Showcases the differences in opacity and evenness when 3 layers are applied to a glass slide substrate that has been warmed (top) versus a room temperature glass slide (bottom)

DISCUSSION

Current progress on the project is promising, however there is still much work to be done. First, we will need to start applying the solution on other substrates. Next, we will start testing the durability of the coating through measures of heat, conductivity, abrasion, and flexural rigidity. The implications of this research will allow us to develop better base solutions for use on items where extreme temperature and pressure fluctuations will occur. Ideally, the coating could be used as an alternative to structures that are fully made with polymer-derived ceramics (PDCs). PDCs are promising, however structures can be expensive to manufacture, so this would act as a cheaper alternative in cases that do not require the same amount of durability throughout.

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