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MATERIALS SCIENCE AND TESTING OF POLYMERS
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Adapting the optical reflectivity of carbon fiber reinforced polymers (CFRP) on nano-scale

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Exploration of the influence of nanoparticles: Matrix vs. Fiber Modification

Nano- and micro-scale structures within composites significantly influence optical and UV reflectivity. A prime example is "Vantablack®," composed of aligned carbon nanotubes with 99.96% absorption. In contrast, fresh snow reflects over 90% of incident light due to scattering within its porous morphology. Drawing inspiration from such phenomena, CFRP epoxy composites can be modified using varying types, sizes, shapes, and quantities of nanoparticles enabling its reflectivity.

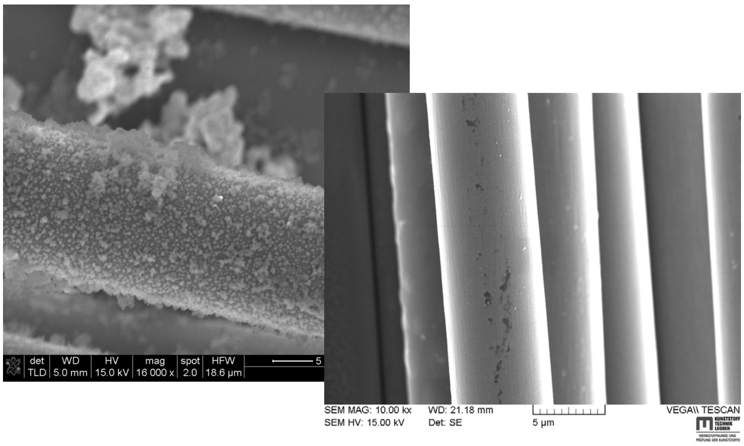
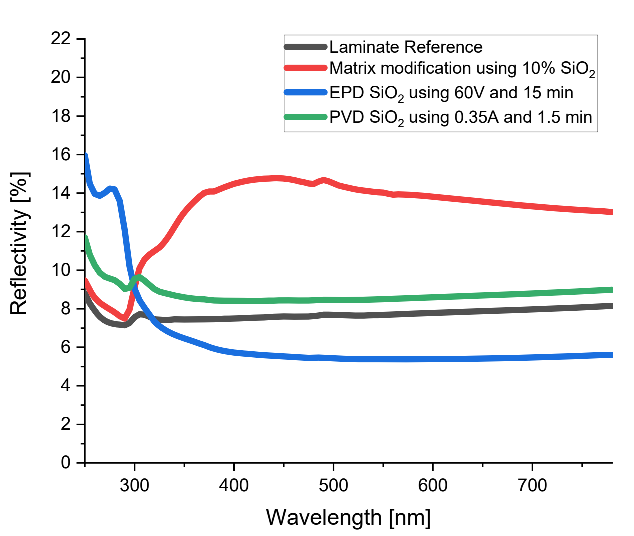


Fig.1

SEM pictures present the morphological structures of silica (SiO_2) deposition onto carbon fiber substrates. On the left, an arrangement of nanoparticles decorate the fibers using electrophoretic deposition (EPD). On the right, a thin film covers the fibers, resulting from applying physical vapor deposition (PVD).



Elevating UV reflectivity enhances durability, while adjusting within optical wavelengths offers visual effects. Using matrix modification, nanoparticles are infused into epoxy resin before lamination. Fiber modifications are conducted using electrophoretic deposition for creating nanoparticle structures and physical vapor deposition for producing nano-scale films on carbon fibers. Measurements via scanning electron microscopy (SEM) show the characteristics of these fiber modifications (Fig.1). Subsequently, the modified fibers are integrated into composite samples and investigated via UV/Vis measurements (Fig. 2).

Fig. 2

Comparing matrix and fiber modifications highlights that matrix modification plays a dominant role in influencing reflectivity within the optical spectrum, while EPD enhances reflectivity in the UV range. PVD modified laminates however, show a slight increase within the whole measured spectrum.

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RESEARCH FOCUS: Polymers composites with specific focus on optical characteristics, interface engineering and mechanical performance

PROJECT: Nanostructured hierarchical CFRP surfaces for tailored visual appearance and improved durability

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