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Perspective

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Cork and solar energy interaction

Luís Gil

Direcao Geral de Energia e Geologia, Portugal

Abstract:

Due to their mechanical properties and their low overall density, carbon fiber-reinforced polymers (CFRPs) are used for many lightweight applications. One disadvantage of these materials is their high flammability, which is relevant for any design using CFRPs in structural components with exposure to heat sources. In order to mitigate this disadvantage, the potential of the physical phenomena of reflection and scattering of thermal radiation by nanoparticles introduced into the matrix material and of their effects on the thermal load capabilities are investigated. Additionally, the potential of those nanoparticles in CFRPs as a protection against laser radiation is estimated. A CFRPs material filled with up to 10 wt.% silver nanoparticles (referring to polymer matrix) shows increasing times to ignition when irradiated from one side with different heat fluxes (35 and 80 kW/m²) by a cone calorimeter. Scattering and specular reflectance of (infrared) light are analyzed, showing enhanced scattering of samples with increasing silver particle content before irradiation, which correlates linearly to the time to ignition and is likely due to particle size. Particle size changes during combustion, as particles melt together and build up reflecting surfaces. With increased amounts of silver nanoparticles, the neat resin of the CFRPs material also shows higher resistance against laser treatment with an UV-laser. For the structural application of this material, no decline in interlaminar shear strength is observed. Additionally, investigations of potential risks for health and environment before, during and after combustion of this new material were performed, because a release of nanoparticles was suspected. Initial results suggest no additional hazard, because silver nanoparticles were only released integrated in resin matrix material at sample production and sample preparation. Furthermore, there was no silver detected in the exhaust gas during combustion of the material.

Biography:

Thomas J Schuster has studied micro and nanotechnology at Munich University of Applied Science. He has completed his Doctorate for investigating carbon nanotubes in carbon fiber-reinforced polymers at Bundeswehr University in Munich. Since then, he is working at WIWeB as an Expert for composite and nanomaterials especially for high energy applications. Additionally, he coordinates national and international collaborations, as well as funding for research projects in the field of military materials.