CHALLENGES IN ENGINEERING COMPOSITES: PREDICTIVE DESIGN, JOINING STRATEGY AND STRUCTURAL HEALTH MONITORING

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Focus Material: Composites

Focus of the Presentation: *(i) Physics-based multi-scale model development*

Abstract

The success of continuous-fiber composites in aeronautics has inspired their use in other applications, including automotive, civil and structural engineering, and piping systems. Even so, continuous-fiber composites are not used to their full potential because (1) the relations between the microstructure and the macroscopic properties are only partially understood, (2) assembly techniques that allow better composite integration need improvement, and (3) development of methods to monitor structures made from such composites remains a challenge. Here, we review these barriers to the full use of continuous-fiber composites in materials engineering and applications and offer illustrative examples of new directions in engineering composites taken by the COHMAS Laboratory. The first example focuses on our work on predictive design of thermoplastic-laminated composites with particular application to the automotive industry. Automotive production techniques and defects differ from those in the aeronautics industry. The short design cycle in the automotive industry requires that new tools be developed that can optimize development of automotive-grade continuous-fiber tapes. The second example looks at new processing techniques that aim to improve the reliability of bonded interfaces, which are critical to achieving bolt-free solutions in civil and structural engineering applications. Our bolt-free or joining strategy relies on patterned interfaces, which can be used on previously cured laminates. Our last example considers structural monitoring. After a brief review of classical monitoring techniques, we present our monitoring strategies that are based on electrical monitoring and on clear understanding of the relations between mechanical damage and electrical properties.

References

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