Inspection techniques for aero engine components of Ceramic-Matrix-Composites using High-Frequency Eddy Current Techniques

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Ceramic-Matrix Composites (CMC) are damage tolerant ceramics that are increasingly established in technical structures, which work in harsh environment, at high temperatures, under corrosive attack and high mechanical loads. That is why these new materials are under development actually amongst others for special components in aero engines. CMC can be based on carbon fibers as SiC (non-oxide CMC) or as oxide-fiber (oxide CMC) reinforcement. Thereby, these composites are suitable for highly stressed components in mobile and stationary turbines. Due to its known advantages for characterization of Carbon-Fiber-Materials, High-Frequency Eddy-Current techniques (HF-EC) have also high potential to characterize CMC. HF-EC is optimized for materials with very low electrical conductivity. Additional, capacity effects and displacement currents plays an increasing role in these application. Due to Silicon Carbide (SiC), has a very low, but present electrical conductivity, a mixture of inductive and capacitive effects as well as effects by displacement currents influences the measurement signal and shows promising results. The main topic of this publication is to evaluate carbon fiber reinforced ceramic matrix composite (C/SiC) at the CFRP, C/C and C/SiC state. The main focus lays on measurements using high-frequency eddy current technique, which has been optimized for these new materials based on extensive and long-term experience of the project team on CFRP materials. Promising results on relevant samples from different production processes and with that varying properties will be presented and discussed and tried to refer towards real material properties or defects within the material.