

**Functionally Gradient Materials**  
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## **Functionally Gradient Thermal Barrier Coatings: Design**

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Functionally gradient thermal barrier coatings (TBCs) were developed for a first-stage vane in a gas turbine engine. Thin (0.625 mm) TBCs were designed. Five NiCrAlY/ZrO<sub>2</sub>-8%Y<sub>2</sub>O<sub>3</sub> gradient interlayer designs were analyzed: step composition layer, narrow linear, wide linear, parabolic, and exponential gradients. The temperature and stress distributions across the coatings were predicted from finite element analysis using the engine conditions, coating design, and material properties. The parabolic and exponential gradient interlayer designs had both the lowest combined stress and stress gradient across the TBC. The TBCs were vacuum plasma sprayed, and their microstructures were evaluated. Additional evaluation is underway.