RESIDUAL STRESSES AND LOAD PARTITIONING IN NOVEL METAL/CERAMIC COMPOSITES EXHIBITING LAMELLAR MICROSTRUCTURES

Siddhartha Roy, Alexander Wanner
Universität Karlsruhe (TH), Institut für Werkstoffkunde I
Kaiserstr. 12, D-76131 Karlsruhe, Germany

Jens Gibmeier
Hahn Meitner Institute Berlin, Structural Research Division
Albert-Einstein-Straße 15, D-12489 Berlin, Germany

The aim of our study is to analyze the mechanics of a new class of metal/ceramic composites on a mesoscopic length scale. These composites are produced by melt-infiltration of porous ceramic preforms produced by freeze-casting and sintering. This production route has a high application potential since it offers a cost-effective way to obtain composites with ceramic content in the range 30-70 vol%. The as-produced material exhibits a hierarchical domain structure with each domain composed of alternating layers of metallic and ceramic lamellae.

We have analyzed the residual stresses present in all phases present in composites produced by infiltrating alumina preforms with a autectic aluminium-silicon alloy. Integral as well as spatially resolved measurements were carried out on both single-domain and poly-domain samples at the high-energy, energy-dispersive diffraction (EDDI) beamline at the synchrotron radiation source BESSY (Berlin, Germany). Results show that considerable and strongly fluctuating residual stresses are introduced by the production process, which can be rationalized based on a mechanical model taking into account the thermal expansion mismatch of alloy and preform. First results from in situ compression tests shedding light on the internal load transfer from the soft and compliant alloy to the hard and stiff ceramic are also presented.

Information Page

Corresponding author:

Prof. Dr. Alexander Wanner
Institut für Werkstoffkunde I
Universität Karlsruhe (TH)
Kaiserstrasse 12
D-76131 Karlsruhe, Germany
Tel.: +49-721-6084160
Fax: +49-721-6088044
Email: alexander.wanner@kit.edu

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