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Micrograded ceramic-metal composites

Guisard Restivo, T.A.(1); Beccari, R.(1); Durazzo, M.(2); Telles, V.(3); Yamagata, C.(2); Silva, A.C.(2); Tenório, J.A.S.(4); Mello-castanho, S.R.H.(5);
(1) UNISO; (2) IPEN; (3) Uniso; (4) EPUSP; (5) Ipen;

Cermet materials are traditional materials for applications as catalysts and solid oxide fuel cell electrodes, i.e. zirconia-Ni and alumina-Ni. The paper shows new designed cermets and processes concerning primary to applications as thermal insulation materials with low emissivity. A new projected microstructure was obtained where dense regions (micropellets) rest inside the main porous pellet. The feature resembles a frozen hypercube (tesseract), therefore such architecture is called hyperpellet. In this way, the material shows both low thermal conductivity and emissivity. The processing method to obtain the hyperpellet cermet is based on 3-steps tape casting forming and 2-steps sintering technique. Metal (Ni) lamellae were prepared by a special mechanochemical process followed by sintering, which remain inside the main pellets as a dense region. The whole pellet is turned to be porous by employing pore former additives. All the constituents and porosity shapes are aligned along the flat disc plane. Micro pellets were also prepared into a rather regular flake morphology type through a suitable granulating process. The thermal conductivity is estimated for hyperpellet type discs and flake powders samples at 800oC by a flash diffusivimeter and compared with commercial ceramic insulation fiber blanked. Ceramography analyses show graded density regions and different constituents and pores with directional feature. Applications of such materials are foreseen as high temperature insulation materials and performant thermal radiation shields.