**Hybrid SPS-Hot Press: A suitable technology for the fabrication of ceramic nanocomposite components for security and defense applications**

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Many defense applications demand ceramic nanocomposite materials combining several structural and functional properties only attainable with a tailored design of the microstructure and an adequate processing strategy that allows the consolidation of the materials into bulk-sized components while preserving the targeted microstructure, and particularly the nanoscale grain size.

Spark Plasma Sintering (SPS) is considered a promising technology for the industrial fabrication of these multifunctional materials since it allows maintaining the intrinsic properties of the initial powders and the formation of fully dense composites unachievable with other conventional methods but the cost effective industrial implementation of SPS for the manufacturing of large and/or complex-shaped ceramic products must overcome several technical limitations such as the availability of suitable technology with special features such as sufficient electrical power output, precise temperature measurement & control, optimized pressing tool systems and hybrid heating system that minimize thermal gradients occurring when using exclusively the Joule heating[1].

Since 2010, the Nanomaterials and Nanotechnology Research Center (CINN-CSIC) in collaboration with Nanoker Research SL is working in the development of new advanced multifunctional materials obtained by hybrid heating equipment (Hybrid SPS-Hot Press system) for space, aeronautics and homeland security applications. The main research areas are ultra-hard ceramic armors for personnel and vehicles, low thermal expansion satellite structures, optical payloads and windows/domes for aircraft countermeasure systems, ceramic matrix composite materials for electromagnetic shielding and thermoelectric applications and composite materials for wireless power transmission. In this work we report the progress in the development of these materials by Spark Plasma Sintering and the challenges that must be addressed for the successful industrial fabrication by hybrid SPS-Hot Press of these materials and their use in components and devices for security and defense applications.

**References**

[1] , R. Torrecillas, H. U. Kessel, J. Hennicke, R. Kirchner and T. Kessel (2013). Challenges and Opportunities for Spark Plasma Sintering: A Key Technology for a New Generation of Materials, Sintering Applications, Dr. Burcu Ertug (Ed.), ISBN: 978-953-51-0974-7, InTech.

**Figures**

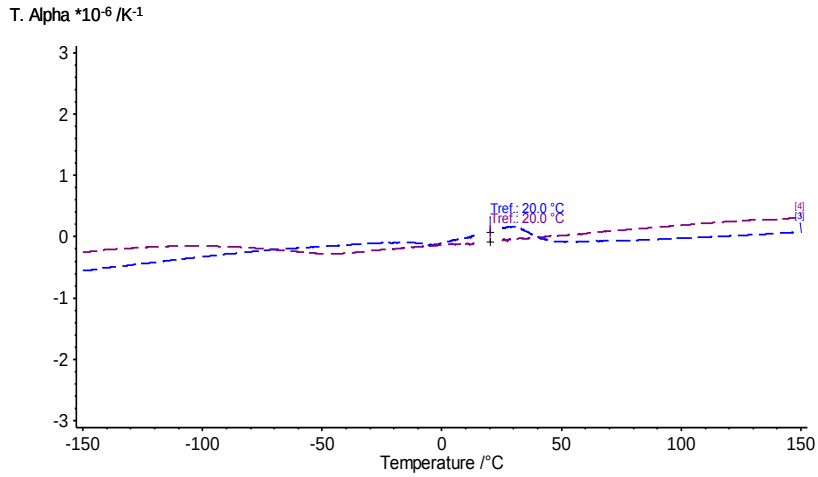


Figure. 1 Dilatometric curves of tnovel ultrastable materials developed by the CINN.

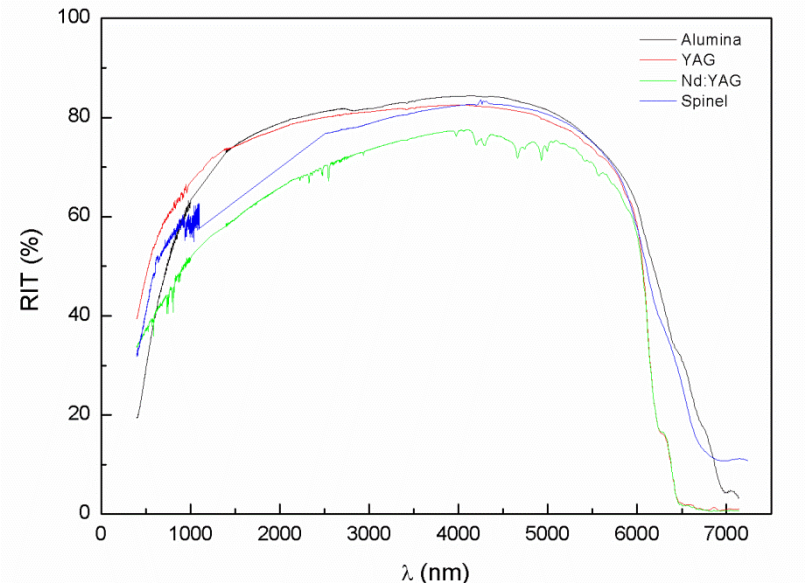


Figure 2. Transmittance curves of some transparent ceramics obtained by Spark Plasma Sintering

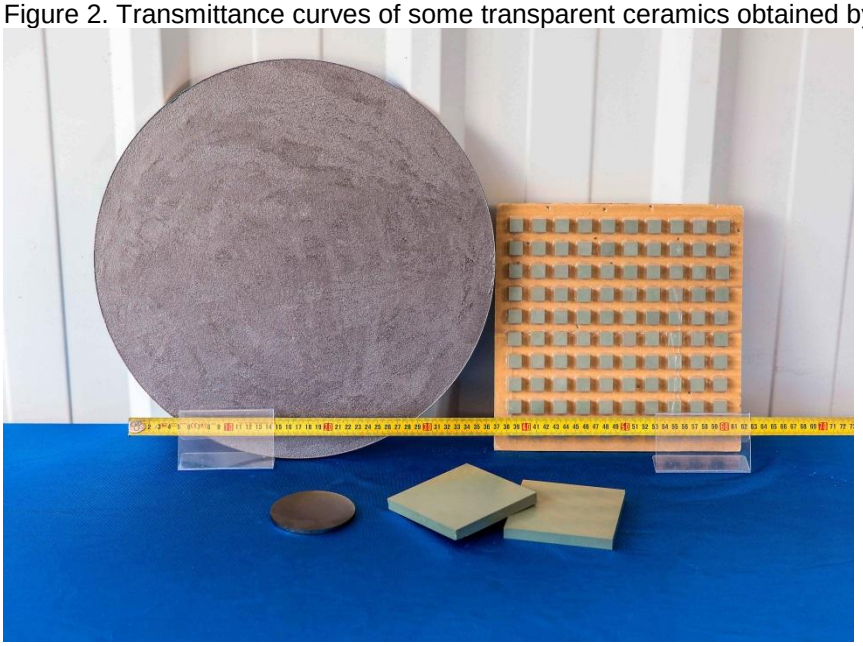

Figure 3. Example of ceramic plates with different sizes and geometries