Details of CARE Facility

Name of CARE facility: Spark Plasma Sintering to Process Materials

Location: Laboratory of Advanced Ceramics (next to Physics Workshop or near to WL extension)

Total cost of equipment/facility: 94.05 Lakhs

Year of CARE funding: 2007-08 and Operational since May, 2008

Support provided by CARE: 55 Lakhs (matching grant of Rs. 39.05 lakhs from a DST Project)

Name of Principal Investigator: Dr. Bikramjit Basu (bikram@iitk.ac.in; Tel: 7771/7920)

Participating departments: MME, ME, ChE, Chemistry, BSBE, EE, MSP

Brief description and capability of CARE facility:

The spark plasma sintering (SPS) process is based on the electrical spark discharge phenomenon. In particular, a high energy, low voltage pulse current momentarily generates spark plasma at the interparticle neck regions of the powder compact. This results in the faster mass transport to the neck region, leading to faster neck growth. SPS sintering temperatures range from low to over 2000^{o}C and such a process has demonstrated its capability to densify materials at much lower temperatures (200 to 500^{o}C) than the conventional sintering. Vaporization, melting and sintering are completed in short periods of approximately 5 to 30 minutes, including temperature rise and holding times.

Technical Specifications:

Sintering Machine: Sintering temperature: Max. 2200^{o}C, Sintering time: Max. 1 h 30 min,
Sintering pressure (Vertical single axis hydraulic press system): 5-50kN
DC pulse generator and energizing system: Voltage: 2-20V, Current: 0-1500A
Sintering operation control panel: Power supply controller, Sintering pressure controller, Vacuum system controller, temperature controller, Current, Voltage, Oil pressure and Stroke indicator.
Analysis Unit: Specimen displacement measuring unit, SPS pressure program control unit, SPS-LCD display system, External output terminal.
Digital radiation thermometer: 600-3000^{o}C
Vacuum chamber and vacuum control unit: Vacuum limit 6 Pa (4.5×10^{-2} torr), Inert gas can be used.
Standard Sintered sample sizes: 15 mm diameter and 20 mm diameter disk samples

Utilization of the facility: SPS can be used for sintering, bonding, surface treatment and synthesis of various engineering materials. The main applications includes: Nanophase materials, Fine ceramics, Functionally graded materials, Electronic materials, Porous materials, Hard alloy tool materials and Diamond tool materials.

Present USERS: Dr. Bikramjit Basu (MME): TiB_2/ZrB_2-based ceramics, Nanoceramics, bioceramics
Dr. Sundar Manoharan (Ch): Inorganic oxide materials
Dr. Rajeev Gupta (MSP): HAp-based Biomaterials

Mechanism of time sharing: open to Institute users every Fridays and on any other day during the week (if required), depending on the urgency of the USER.

Any difficulties, which you faced in running CARE facility: No full time technical personnel to look after this CARE facility is available at present. PhD students help the users of this machine.