4:40 PM

(ICACC-FS5-007-2015) (Cd,Mn)Te as a New Material for X - ray and Gamma – ray Detectors (Invited)

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The semiinsulating (Cd,Mn)Te crystals are believed to be materials suitable for effective manufacturing of large area X- and gamma – ray detectors, instead of commonly used (Cd,Zn)Te and CdTe crystals. The purpose, was to elaborate a technology of the (Cd,Mn) Te crystals plates with high resistivity, uniform in the whole volume of the plate, and with high homogenous $\mu\tau$ product, where μ and τ are drift velocity, and lifetime of carriers, respectively. The semiinsulating (Cd,Mn)Te crystals, doped (for compensation) by vanadium (V) or Cl or In, or Cl together with V, were grown by the Bridgman method. The monocrystalline plates were cut out of the ingot. The plates were annealed in the Cd-vapour. After annealing the resistivity of the plates was around 10^9 Ωcm, and the $\mu\tau$ – product was from10^{-4} to 10^{-3} cm^2 /V. Annealing in the saturated Cd vapours influenced the amount of tellurium inclusions/precipitates. The photoluminescence (PL), time resolved photoluminescence (TRPL), and electron paramagnetic resonance (EPR) measurements indicated that after annealing the concentration of intrinsic acceptors (V_{Cd}) become significantly lower. Density and structure of defects were measured by the etch pit density (EPD) and scanning electron microscopy (SEM). The best electrical contacts to semiinsulating (Cd,Mn)Te crystal plates were made by the amorphous layer of Sb doped ZnTe covered by an Au layer.

5:10 PM

(ICACC-FS5-008-2015) Shaped Scintillating Materials (Invited)

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Scintillating materials are widely used in many applications where ionizing radiation detection is needed. Their requirements in terms of performances depend on the final application and on the way they are used . A significant number of parameters are generally checked such as scintillation yield, decay time, density and effective atomic number, chemical and mechanical stability, radiation hardness, index of refraction, industrial capability to produce large quantities, etc... Another crucial point is the shape. Scintillators are thus used as single crystals (high-energy physics, medical imaging, etc.), as powders (X-ray phosphors), needles, organic or inorganic fibers, and even as liquids . The aim of this presentation is to provide a review of this latest aspect, combining illustration of various needs, current capabilities, performences and achievements.

FS6: Field Assisted Sintering and Related Phenomena at High Temperatures

Flash Sintering Phenomena and Mechanisms

Room: Coquina Salon H
Session Chair: Rishi Raj, University of Colorado

1:30 PM

(ICACC-FS6-001-2015) The Phenomenon of Flash Sintering: Scientific and Technological Implications (Invited)

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In flash sintering, ceramics that nominally require several hours at temperatures near 1500 oC, sinter to nearly full density in a matter of seconds at furnace temperatures that may lie below 1000 oC, under modest electrical fields applied directly to the specimen. The "flash" not only produces ultrafast rates of self-diffusion, which is needed for densification, but also a dramatic increase in electrical conductivity, as well as intense electroluminescence in the visible range. Thus, the uncharged (sintering) and charged (conductivity) species, and the production of photons (e-h recombination?) occur all at once. These aspects of this unusual phenomenon will be discussed. The short sintering time and low furnace temperatures may offer new ways of manufacturing ceramics, for example by a continuous rather than a batch process. An example of such a system will be described. Supported by the Basic Energy Sciences Division of the Department of Energy and by the Office of Naval Research.

2:00 PM

(ICACC-FS6-002-2015) Electric field-assisted sintering of zirconia-3 mol% yttria

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Green pellets of ZrO2:3 mol% Y2O3 were sintered by applying ac (60 Hz and 0.5-1.1 MHz) electric fields (typically 100 V.cm-1) during the first stage sintering process (T < 1200oC). The experiments were carried out positioning the specimens inside a vertical dilatometer with platinum disks acting as electrodes in a capacitor-like setup. The shrinkage level was controlled by monitoring the dilatometer gauge, allowing either for stopping the shrinkage at pre-determined shrinkage levels or applying the same voltage at the same temperature during the same period of time. Under the same conditions of temperature and magnitude of the applied ac voltage, the threshold shrinkage level attained for similar green pellets was found to depend on the frequency of the applied field. This result signals to suggest that the amount of Joule heating imparted to the specimen depends on the number of charge carriers (mainly oxide ions) collisions. A phenomenological mechanism taking into account the enhancement on the intrinsic thermodynamic oxide ion vacancy concentration due to localized Joule heating is proposed as the main responsible for sintering.

2:20 PM

(ICACC-FS6-003-2015) Towards the flash sintering of zirconium diboride

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Flash sintering is an exciting development in ceramic processing where densification temperature and time are greatly reduced through the application of an electric field. As a result, flash sintering uses considerably less energy and therefor has the potential to enable new applications for materials where processing is traditionally cost-prohibitive. Zirconium diboride is an ultra-high temperature ceramic (UHTC) for which low-cost processing would be a real boon. Successful flash sintering of zirconium diboride could be transformative for applications in atmospheric re-entry, hypersonic flight, and continuous metallurgical processing. Flash sintering experiments are conducted in a custom-built pressure-less desktop furnace. Three different powders are tested over a range of direct-current voltages and temperatures. Archimedes density measurements, gas pycnometry, scanning electron microscopy, and hardness measurements are used to characterize the processed samples. Additionally, energy-dispersive synchrotron x-ray diffraction (EDXRD) is used to monitor the process in situ with high temporal resolution. Variance of electric field shows little effect on density outcome. Isotropic expansion of lattice parameters is observed with correlation to the current flow in the sample.