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# Structural analysis of neutron-irradiated co-doped ($Ba_{0.88}Ca_{0.12}Ti_{0.975}Sn_{0.025}$)$O_3$ ceramic

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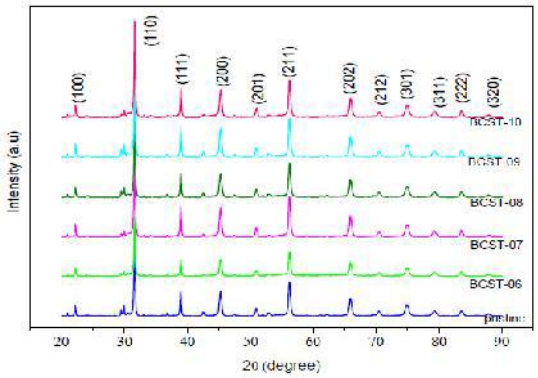
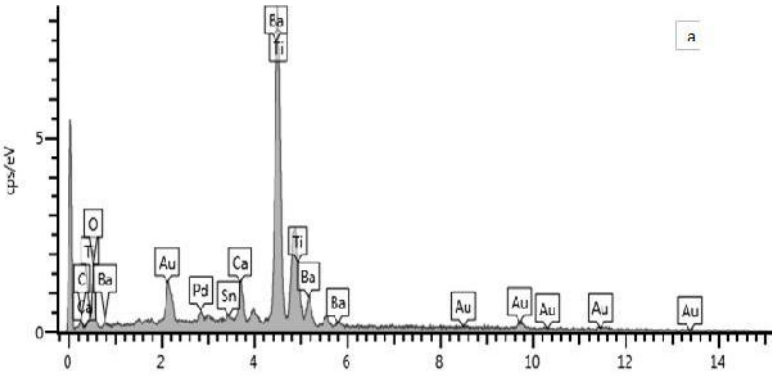



XRD patterns of pristine and irradiated ($Ba_{0.88}Ca_{0.12}Ti_{0.975}Sn_{0.025}$) $O_3$ ceramic




EDS spectrum of (a) pristine co-doped $BaTiO_3$

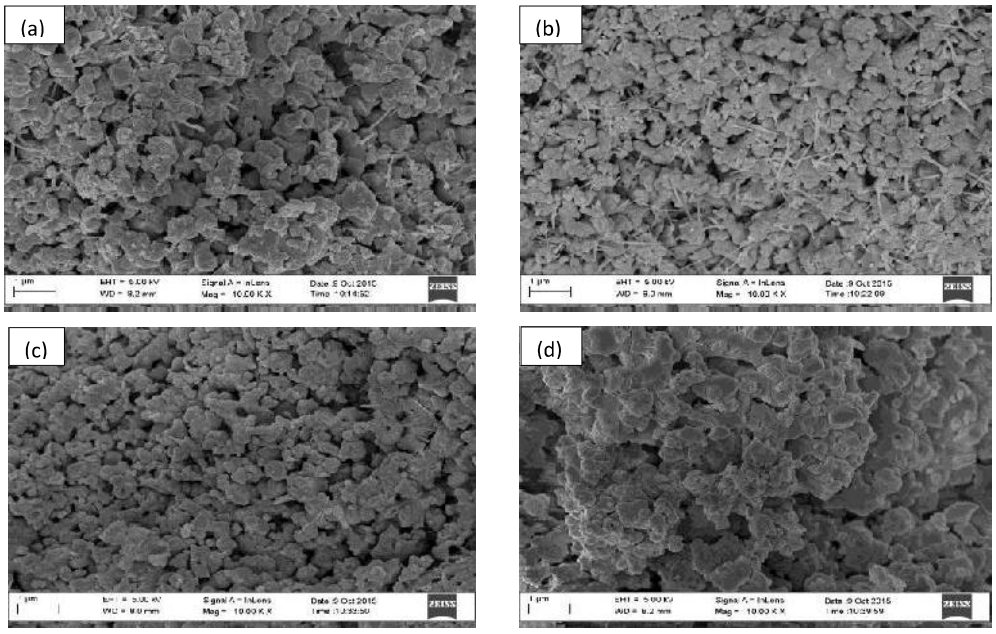



Figure 2: HRSEM micrographs of (a) pristine (b) BCST-06 (c) BCST-07 (d) BCST-08

## ABSTRACT

Barium Calcium Stannate Titanate ($Ba_{0.88}Ca_{0.12}Ti_{0.975}Sn_{0.025})O_3$ ceramic synthesised by solid state reaction was subjected to neutron irradiation fluence of up to $10^{10}$ n/cm$^2$ using Am-Be neutron source. The pristine and irradiated samples were investigated and characterised by X-ray diffraction and SEM/EDS. XRD patterns confirmed the ceramic is single crystalline phase with the tetragonal perovskite structure which did not change after irradiation. The average crystallite size increased from 26.35 nm for pristine sample to 28.32, 26.89, 27.05, 27.25, 28.50 nm for samples irradiated at 0.0, $8.10 \times 10^6$, $9.72 \times 10^7$, $8.75 \times 10^8$, $6.99 \times 9$ and $1.399 \times 10^{10}$ n/cm$^2$ neutron fluence, respectively. Similarly, the c/a (tetragonality) ratio was virtually constant. Average grain sizes of 5.80, 10.20, 6.70, 11.19 and 13.07 μm were obtained. The pristine sample showed some agglomerations with fairly fined grained microstructure and rod-like grains while the sample irradiated at $8.10 \times 10^6$ n/cm$^2$ has lesser agglomerations of grains. The rod-like microstructure disappeared and a relatively homogeneous microstructure arose upon irradiation of fluence $9.72 \times 10^7$, $8.75 \times 10^8$, $6.99 \times 9$ and $1.399 \times 10^{10}$ n/cm$^2$. Elemental analysis confirmed the presence of Ba, Ca, Ti, Sn and O in the pristine sample. It is concluded that neutron irradiation may not affect the ferroelectric and dielectric properties and the material is safe to use in neutron radiation environment of these fluence.

**Keywords:** Barium titanate; neutron irradiation; ferroelectricity; structure analysis .

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# Effects of nitriding-shot penning surface treatment to die soldering behaviour of H13 and Cr-Mo-V tool steel on die casting process

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## ABSTRACT

Die soldering is sticking phenomenon between molten aluminium with the surface of steel die material in Die casting process, which makes cast products difficult to eject or some of them remains there after the ejection of the part . This resulted in low productivity and economic value in the foundry industry .In order to minimize die soldering, surface treatments such as shot peening and nitriding were done on the die material. In this research, two kind of die material, H13 and Cr-Mo-V steel were treated by two variables ,shot blasting- shot peening and nitriding-shot peening surface treatment. For die casting process simulation, the samples were dipped into molten aluminum-Si alloy of ADC12 at 680$^{o}$C with three variables of dipped times 0.5; 5; 30 minutes. Characterizations on the surface of the steel were focused on the optical microstructure, microhardness profile, FE SEM observation and enegy dispersive spectrometry mapping for identification of phase and intermetallic compund and weight loss measurements. It was found that H13 steel and Cr-Mo-V steel treated by nitriding–shot peening (N-SP) have two times higher of hardness than are treated by Shot Blasing- Shot Peening (SB-SP) and less in thickness of Intermetallic layer. On H13 steel the thickness of compact layer thickness decreased from 19 µm to 17 µm and the thickness of broken layer also decreased from 96 µm to 80 µm. On Cr-Mo-V steel the thickness of compact layer decreased from 38 µm to 19 µm and the thickness of broken layer also decreased from 119 µm to 45 µm. These results Indicate that H13 and Cr-Mo-V steel that treated by nitriding–shot peening (N-SP) have a better resistance to die soldering than are treated by Shot Blastng-Shot Peening (SB-SP) by the formation of less thickness of intermetallic and Broken layers. It was also found that the higher the hardness of surface material, shows lower tendency to the die soldering effect.

**Keywords:** Intermetallic layer; die casting; die soldering; shot peening; nitriding.

 