

## PbSe nanoprecipitates produced by ion implantation in Si (001) and SOI

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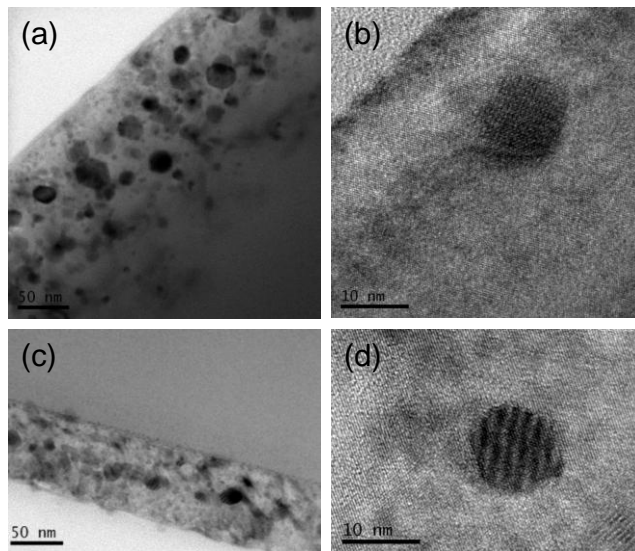
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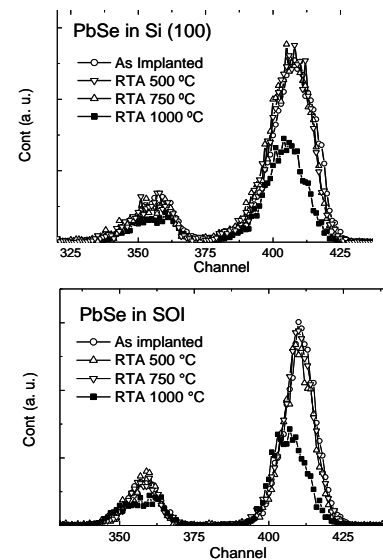
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**Abstract** – The formation of PbSe nanocrystals in Si(001) and Silicon-On-Insulator (SOI) substrates via ion-beam synthesis is investigated by Transmission Electron Microscopy and Rutherford Backscattering Spectrometry. The results obtained demonstrate that solid state chemical reactions leads to the formation of PbSe nanocrystals compounds, but their stoichiometry strongly depends on the implantation and annealing parameters.

Transmission Electron Microscopy (TEM) and Rutherford Backscattering Spectrometry (RBS) techniques are applied to study the formation and growth of PbSe nanocrystals produced by ion beam synthesis in Si(001) and SOI substrates. The samples were sequentially implanted with Pb and Se ions at 400 °C, to fluences of  $\phi=1 \times 10^{16} \text{ cm}^{-2}$  and  $\phi=5 \times 10^{15} \text{ cm}^{-2}$ . Furnace (800 °C, 11h) and RTA (500, 750 and 1000 °C, 120 s) annealings were performed. TEM observations reveal the presence of PbSe nanocrystals as well of extended defects (Fig. 1). For the RTA annealed samples, RBS measurements demonstrate complete retention of the implanted material for annealing treatments at  $T \leq 750 \text{ °C}$  while, for  $T=1000 \text{ °C}$ , there are higher losses of Pb ( $\approx 50\%$ ) than of Se ( $\approx 30\%$ ), and occur only for the high fluence case (Fig. 2). The losses observed in furnace annealed samples results in a 1Pb:2Se relation. These results are discussed in terms of solid state chemical reactions depending on the implanted fluence, annealing temperature and time.



**Figure 1:** TEM images of PbSe nanocrystals, (a) and (b) low magnification and high resolution of PbSe in Si (001), (c) and (d) PbSe in SOI substrate.



**Figure 2:** RBS measurements of Pb and Se implanted into Si and SOI substrates. As implanted and RTA annealed samples ( $\phi=1 \times 10^{16} \text{ cm}^{-2}$ ).