Nanocrystal silicon growth under electron irradiation

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In our experiment, it was observed that silicon nanocrystals rapidly grow with irradiation of electron beam on amorphous silicon film prepared by pulsed laser deposition (PLD), and silicon nanocrystals almost occur in spherical shape on smaller nanocrystals with less irradiation time of electron beam. It is very interesting that magical electron affection promotes growth of nanocrystals due to nanoscale characteristics of electronic de Broglie wave which produces resonance to transfer energy to atoms. In the process, it was investigated that condensed structures of silicon nanocrystals are changed with different impurity atoms in silicon film, in which localized states emission was observed. Through electron beam irradiation for 15min on amorphous Si film doped with oxygen impurity atoms by PLD process, enhanced photoluminescence emission peaks are observed in visible light. And electroluminescence emission is manipulated into the optical communication window on the bigger Si-Yb-Er nanocrystals after irradiation of electron beam for 30min.

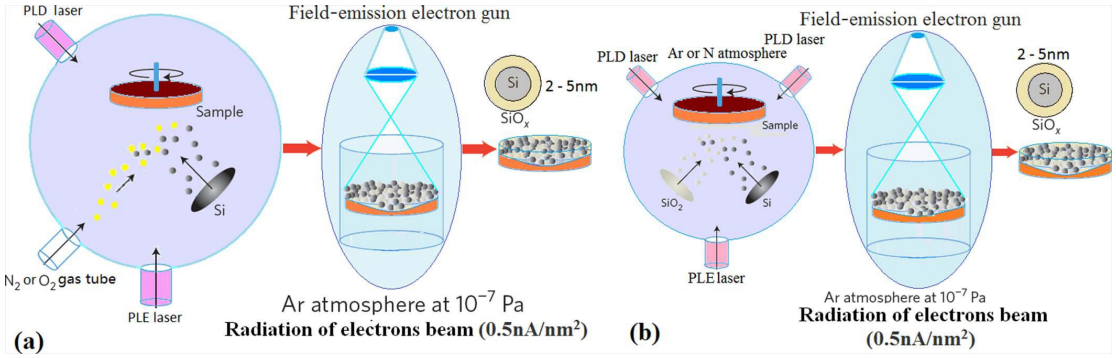


Figure 1 | Combination fabrication system with electron beam irradiation device, PLD and PLE devices, in which at first the amorphous Si film forms, then Si nanocrystals grow up under irradiation of electron beam and Si QDs embedded in SiOx or in SiyNx are produced.

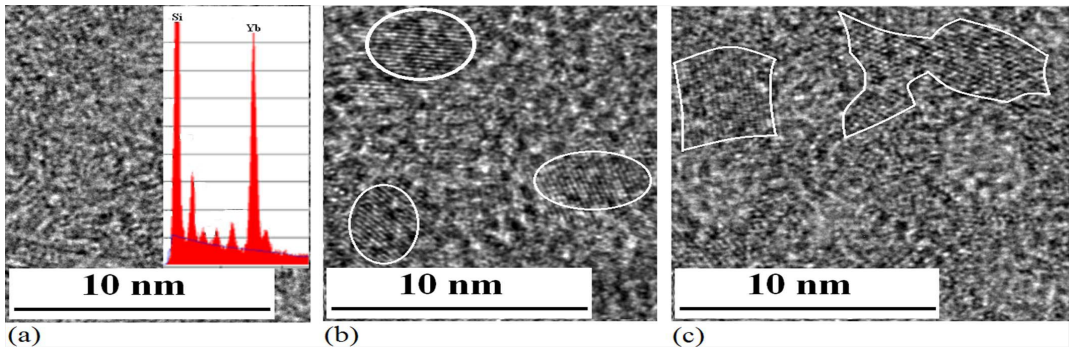


Figure 2| TEM images of Si nanocrystals growing process. (a) TEM image of Si–Yb–N structure on amorphous film after irradiation of electron beam for 5min, in which not only QDstructure has been observed, and inset shows composition of Si and Yb in X-ray energy spectrum on the amorphous film. (b) TEM image of Si–Yb QDs embedded in SiyNx amorphous film after irradiation of electron beam for 20min. (c) TEM image of Si–Yb nanocrystals with various shapes embedded in SiyNx amorphous film after irradiation of electron beam over 30min, in which QDs structure has been broken

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