

# Formation of Si and Ge nanocrystals in dielectric layers

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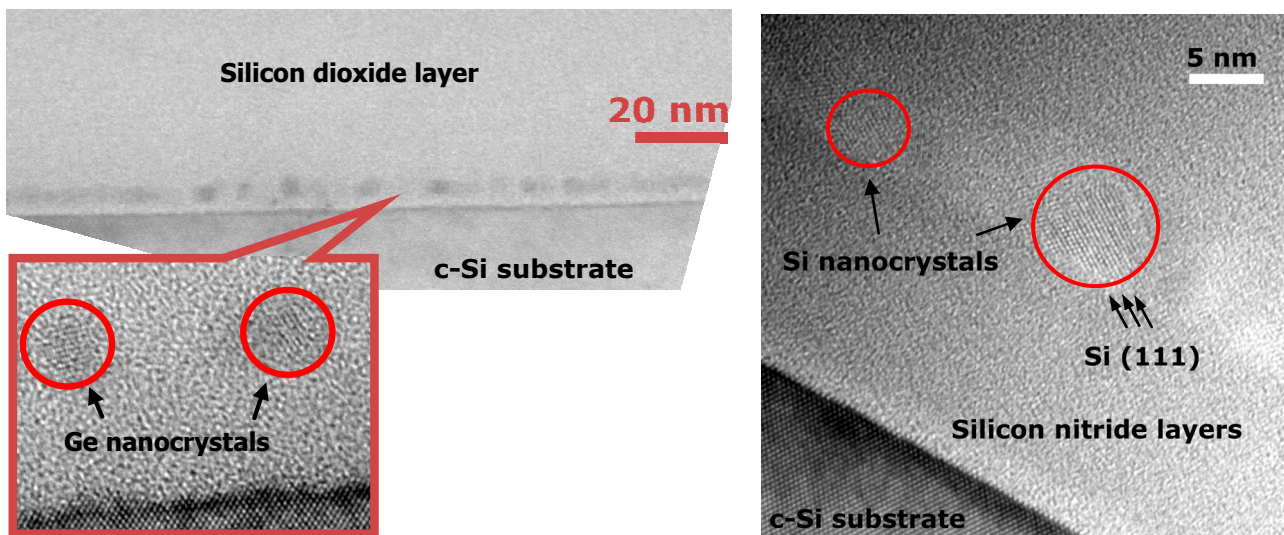
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The synthesis of semiconductor nanocrystals (with sizes ranging from a few to few tens of nm) in dielectric host materials has been demonstrated and deeply examined during the past ten years according to the literature [1]. However, the way of their application in advanced solar cell structures has not been clarified, recent ideas are promising. Relevant examples are (1) using a mixture of an organic absorber and group IV nanocrystals for the so-called bulk heterojunction material in organic solar cells [2], or (2) exploiting the high-efficiency carrier multiplication in semiconductor (compound or even Si) nanocrystals, i.e. increasing the impact ionization efficiency [3–4]. This latter means the generation of multiple electrons from high-energy photons, and hence, could lead to a new type of solar cell that doubles the efficiency of today's typical photovoltaics [4]. As currently the largest barrier to the widespread adoption of solar cells is their cost, combining the low manufacturing and material cost of organic solar cells and the increased solar conversion efficiency of Si nanocrystals could be a plausible direction of research.

Our group has expertise in preparation of Si and Ge nanocrystals with nanocrystal sizes between 2 and 20 nm, in SiO<sub>2</sub> or Si<sub>3</sub>N<sub>4</sub> dielectric thin layers [5–6]. We use low-pressure chemical vapour deposition or e-beam evaporation for the nanocrystal formation, without any post-annealing process. As the deposition of nanocrystals is a separate single step, it is independent of the host dielectric material, and hence, opens the way for nanocrystal formation on other substrates. High-resolution cross-sectional transmission electron microscopy images are shown below to illustrate our capability of forming Si and Ge nanocrystals.



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- [3] R. D. Schaller and V. I. Klimov, *Physical Review Letters* 92, 186601 (2004)
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