Surface passivant control of Si nanocrystal luminescence

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The effect of surface passivant on nanocrystal Si (nc-Si) luminescence is investigated. Films with simiarly sized nc-Si but surface passivant ranging from pure silicon dioxide through silicon oxynitride to pure silicon nitride were prepared by depositing amorphous SiO_xN_y films by reactive ultra-high vacuum ion beam sputtering followed by high temperature annealing.

We find that as the surface passivant is changed from silicon dioxide to silicon oxynitride, the nc-Si photoluminescence (PL) intensity decreases strongly. As the oxygen content of the surface passivant is reduced further, PL spectrum starts to blueshift, finally reaching a peak value of 2.0 eV when pure silicon nitride layer is used. The results are in good qualitative agreement with theoretical predictions[1,2], and indicates that nitride passivation of nc-Si is effective in relaxing the strong strain at the nc-Si surface that can lead to reduction of nc-Si bandgap.

References

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