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Linear and non-linear light emission of Er-hybridized Si nanostructures in the ultrathin geometry

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Resume : Advanced integrated photonic devices will include active metamaterials in which plasmonic and photonic modes will be used to manipulate the light in nanoscale dimensions. Efficient, robust, and optically modulated nanoscale light emitters with high color purity are required as active building blocks for these metamaterials. A single ultrathin layer (few nanometers thick) formed by Er ions coupled to Si nanoparticles or nanostructures (NSs) is suitable for such a purpose, since RE ions provide a robust emission that can be enhanced by using the Si NSs as sensitizers. However, it is necessary to investigate the potential of these nanoscale systems for light emission and modulation. // In this work we report the light emission properties of ultrathin (< 8 nm) hybrid Er-Si NSs layers, in which all the Er ions are located at few nm of the Si NSs in order to obtain unprecedently high sensitization efficiency. Clear IR Er light emission from an ultrathin layer containing less than 2.5% of an atomic monolayer of Er under near-ultraviolet and visible excitation. Moreover it is found that the emission of the Er-Si NSs layers shows a complex non-linear behaviour as a function of the excitation photon flux. We will discuss how these Er-Si NSs layers possess a high functional versatility, and can be used as efficient nanoscale near IR light sources the emission of which can be modulated optically.