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Enhancing the Luminescence of Silicon Nanoclusters embedded in Silicon Nitride

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In the quest to develop a silicon (Si) based light source, for optical and optoelectronic applications, researchers have explored various techniques. One such technique is the use of self-assembled Si-nanoclusters (Si-NC) embedded in a silicon nitride (Si3Nx) matrix. This system has shown great promise, displaying both photoluminescence and electroluminescence.[1,2] Despite such achievements, the luminescence of Si-NC/Si3Nx devices is still too low in intensity to be used in a commercial light source. An approach that has recently gained interest is the luminescence enhancement of Si-NCs using the localized surface plasmon resonance (LSPR) of metallic nanostructures (m-NS). The majority of research in this area has focused on the use of metals such as gold (Au) and silver (Ag), which are expensive and would increase the cost of any device made using them.[3-6] In our group, we explore how m-NS made using aluminum (Al) can be tailored to enhance the luminescence of Si-NC/Si3Nx devices. Al has the added advantage of being compatible with current manufacturing techniques. To fabricate these m-NS we use nanosphere lithography (NSL). We also examine the mechanisms of luminescence of our Si-NC/Si3Nx devices, to facilitate improvements in luminescence intensity.[7] The results of our work will facilitate the development of commercially viable and cost efficient Si-based light emitting devices.

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