# Field enhancement at silicon-oxide interface layers generated by Au island films

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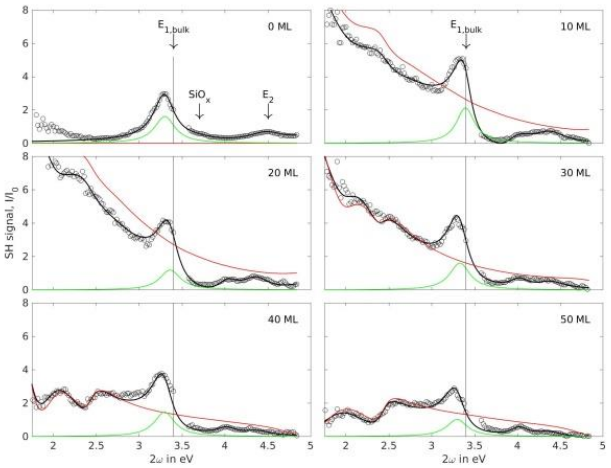
A promising applications of nanoplasmonics is the design of metallic structures that enhanced light absorption in thin film solar cells [1] where the active layer has poor light absorption. In this work field enhancements from Au ellipsoids with diameters from 30 to 250 nm deposited on a Si substrate with a thin 1 nm thick surface oxide have been investigated by second harmonic generation spectroscopy. *The basic idea of this work is to follow the relatively sharp SHG resonance from Si near the $E_1$ critical point in order to deduce the field enhancement inside a thin Si interface layer.*

The measured linear optical properties are well described by the island film model [2] and are used in the investigation of the SHG signal.




At energies below the $E_1$ critical point energy a strong SHG signal originating from plasmon resonances in the Au particles is observed. By following the evolution of the characteristic Si SHG-resonance it is found that the Au particles affect the Si SHG signal in two ways: 1) charge transfer from the substrate to the metal modifies the band bending in Si and gives rise to E-field induced SHG (EFISH) and 2) local enhancement of the field at the Si-oxide interface. For small particles the EFISH part dominates while for larger particles the field enhancement at the Si-oxide interface dominates the SH signal and a field enhancement factor in Si of 4 is found experimentally. This is about a factor of 5 less than the corresponding factor calculated by the local field factors when the separation between Au islands and the Si interface region is neglected. It is suggested that the fast decay of the local field away from the metal islands reduces the observed field enhancement.

*Keywords:* Plasmonics; Field enhancements; Nonlinear optics

**References**

[1] H. A. Atwater and A. Polman, Nature Materials 9, 205 (2010).
[2] P. Bobbert and J. Vlieger, Physica A: Statistical Mechanics and its Applications 147, 115 (1987).