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Nano plasmonic particles for sensor applications

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When surface plasmon wave of two different nano particles (aluminum (Al) and gold (Au) nano-particles) were combined, we observed plasmon resonance peak at two different wavelengths different from the constituent plasmonic resonance wavelength. We used electron beam lithography along with angle metal evaporation techniques to deposit metal particle plasmon layer with nanometer-scale separation. The resonance Plasmon peak wavelength of two Plasmon particles with nano meter separation for sensor application will be discussed in details. The area of creating artificial molecules by combining more than one nanoparticle (NP) has received significant interest recently. Similar to the way atoms join together in different combination to form all the substances in the universe, we too can make groups of new materials by combining artificial atoms or NPs. The strong interaction of plasmon waves from different NPs can render many applications possible, including sensors, and enhanced electro catalytic reactions. We used an electron beam lithography process along with angle evaporation techniques to achieve nanometer-scale metallic particles with very close proximity. Gold (Au) and aluminum (Al) metal particles were chosen for the plasmonic coupling experiment because of their distinguished plasmonic behavior with peak wavelengths separated by few 100 nm. We used a variable angle ellipsometer model M-2000 from J. Wolman and Company to measure change in phase difference, Δ, due to plasmonic NPs. The peak resonance wavelength for different plasmonic material was determined. Two metallic NPs were deposited using different angles of evaporation of substrate with respect to metal crucible. We observed two peaks: one narrow plasmon peak at 525 nm showing a contribution from the Al NPs and another broad plasmon peak at 650 nm due to the Au NPs. We have shown two-color plasmon absorption peaks due to Al and Au NPs with a nanometer-scale separation between them. The position and peak height of the coupled plasmon curves are different from the individual peaks of Al and Au NPs, respectively.

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The science of optical micro resonators: Chipscale optical frequency combs

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Optical frequency combs provide equidistant markers in the IR, visible and UV and have become a pivotal tool for frequency metrology and are the underlying principle of optical atomic clocks, but are also finding use in other areas, such as broadband spectroscopy or low noise microwave generation. In 2007 a new method to generate optical combs was discoverer based on high Q optical microresonators. Micro-resonator frequency combs offer high repetition rates in the technologically relevant GHz regime. Moreover the parametric gain is broadband enabling frequency combs that can extend over a full octave without external broadening. In addition, micro-resonators are amenable to planar integration allowing further electronic and optical integration on a chip. The developments at EPFL will be reviewed, and results using SiN planar microring resonators and ultra high Q crystalline MgF2 resonators presented. In particular low noise broadband comb operation will be discussed, their use in coherent telecommunicationsfor terabit/second coherent datacommunication and the extension of these Kerr frequency combs to the mid-IR. Moreover the formation of dissipative temporal solitons discovered in microresonators will be discussed. Using time domain broadening and 2f-3f self referencing, these temporal soliton states have allowed counting the optical cycles of light using a microresonator. In addition we demonstrate higher order soliton based broadening phenomena in a SiN microresonator, allowing the direct generation of a fully coherent optical frequency comb that spans 2/3 of an octave using a continuous laser pumped SiN microresonator.

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