Latest Progress in Spasers

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Nanoplasmonics deals with collective electron excitations at the surfaces of metal nanostructures, called surface plasmons. The surface plasmons localize and nano-concentrate optical energy creating highly enhanced local fields. Nanoplasmonics has numerous applications in science, technology, biomedicine, environmental monitoring, and defense.

There is an all-important need in active devices capable of generating and amplifying coherent optical fields on the nanoscale analogous to lasers and amplifiers of the conventional optics or transistors of microelectronics. Such an active device is the spaser (surface plasmon amplification by stimulated emission of radiation), also called plasmonic nanolaser. We will focus on the newest ideas and achievements in spasers.

We will present two new theoretical ideas in the field of spasers: spaser with electric pumping via quantum wire [1] and quantum-cascade graphene spaser [2]. We will consider an example of the latest progress in spasers [3] and some applications of spasers. Among them is a recent breakthrough in ultrasensitive detection of explosives using the spaser [4]. Another recent breakthrough to be presented is an application of the spaser as an ultrabright nanolabel and an efficient theranostic agent in biomedicine (cancer diagnostics and treatment) [5].

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