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Letters

Proposal for an Electrically Tunable Surface Plasmon Light Emitter

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Abstract—**A new scheme is proposed to generate infrared waves by exciting thin-slab plasmon waves by hot-electron injection via a tunneling thin insulator. These plasmon waves are coupled out by a periodic structure, and, by way of example, this is demonstrated for a Karp structure. The calculated numerical values of the example at a wavelength of 15 μm, show that standard semiconductor technology can be used to fabricate the device.**

A Proposed Infrared Emitter Excited by Surface Plasmons

It has been demonstrated experimentally that planar Metal–Insulator–Metal (MIM) junctions can be used to excite radiative surface plasmon modes [1]. There is convincing evidence that enhancement of light emission takes place [2] from such structures (e.g., Al–Al_2O_3–Ag or Mg–MgO–Ag MIM junctions), when the metal surfaces are roughened. While in early experiments, the light emission was very faint, in a more recent experiment [3] which might also partly be based on radiative plasmon modes, it was visible to the naked eye in a darkened room. In this case the substrate was gallium arsenide and the insulating layer was a native oxide. It has to be stated, however, that the exact origin of the GaAs MOS emission has not yet been established and that several other light-emission effects could here simultaneously be responsible for the observed spectrum.

Better control over radiation based on radiative plasmon modes should be achievable by using slow-wave structures instead of random irregularities in the surfaces. This case represents an interesting analogy with space charge waves of an electron beam coupled to a slow-wave structure. Efficient energy transfer would be facilitated when the frequency and the phase velocity for the electromagnetic field and the space charge waves nearly match with each other.

The purpose of this communication is to present a proposal for such an infrared emitter, with possibly even some tunability.

Various combinations are possible for exciting surface plasmons. Here we propose to use hot carriers to be injected by tunneling through a suitably thin insulating layer into a metal or semiconductor layer, where both normal and tangential modes of

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