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Amplification and Lasing with Surface Plasmons

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Optical processes such as spontaneous/stimulated emission and absorption may occur with surface plasmon polaritons (SPPs) as they interact with an optical gain medium, ultimately leading to SPP amplification and oscillation (lasing) under the right circumstances. Although SPP amplifiers and lasers have been topics of investigation for about three decades, demonstrations of both have only recently been reported. In particular, the amplification of long-range (low-loss) SPPs on metal slabs and stripes has been demonstrated experimentally using a reasonable pump power and optical dipole concentration in solution, and as such is among the more practical SPP amplification systems proposed to date. Long-range SPP amplifiers also produce compelling noise characteristics due to lower spontaneous emission into the mode being amplified. Their integration with Bragg gratings leads to a single-mode laser producing a narrow emission linewidth - much narrower than that of more confined surface plasmon lasers. These topics are reviewed and discussed, their status is assessed, and directions for future research are suggested.

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