Temporal Response of a Plasmonic Antenna

M. BECKER, C.-W. HUANG, R. BACH, H. BATELAAN, Department of Physics and Astronomy, University of Nebraska - Lincoln, E. SMYTHE, F. CAPASSO, School of Engineering and Applied Sciences, Harvard University — Using femtosecond lasers, we investigate the temporal response of a plasmonic antenna [1]. This structure is fabricated by Capasso’s group. In this report, we propose an application of such a plasmonic antenna: femtosecond electron switching. The plasmonic antenna may be very effective in influencing the motion of free electrons because the intensity of an input electric field can be enhanced by up to a factor of a thousand in the near field [2]. Our estimates indicate that the plasmonic antenna can cause large deflection angles of about 0.1 radian upon applying a 10 nJ, 10 femtosecond duration laser pulse. Therefore, a low power, high repetition rate femtosecond laser may be used to excite the plasmonic structure and influence electrons’ motion at the femtosecond time scale, leading to a femtosecond electron switch. We want to experimentally determine this dynamical response of the antenna. A preliminary test of the plasmonic antenna shows that it can respond in the femtosecond regime. Detection schemes that are sensitive to about 10 femtoseconds are now being explored. [1] Elizabeth J. Smythe, Ertugrul Cubukcu, and Federico Capasso, Opt. Exp. 15, 7439 (2007) [2] Ertugrul Cubukcu, et al., IEEE J. Sel. Top. Qu. Elec., Vol.14, No.6, 1448 (2008)

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