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Light Localization in Quasi-Periodic Nano-Photonics Carpets

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In this work we show the formation of quasi-periodic field carpets and strong localization of light in the proximity of a planar quasi-crystal array of nano-holes in metallic screen.

The classical self-imaging Talbot effect is known to self-reproduce images of planar periodic structures at well defined distances from the plane of the structure, when illuminated with coherent light. Our researcher extends the Talbot effect into the domain of quasi-periodic structures. We show that quasi-periodic structures manifests field pattern formation at distances from the structure as large as a few tenth of wavelength when illuminated with coherent or incoherent light. At cetin distances the field distributions assume the form of colorful field carpets or partially self-image the array structure of holes. Our experiment we used thermal white light and laser white light sources as well as highly coherent narrow band lasers. The field patterns were recorded using high-numerical aperture microscopy wish spectral resolution and spectrally resolved transmission Scanning Near-field Optical Microscopy (SNOM). Several unusual features have been seen such as the formation of intense white spots in the carpet, polarization dependence of the field distribution and above all the formation of highly localized and isolated hot-spots of energy concentration. Along side with the experimental results we provide matching theoretical calculations which take into account diffraction, plasmonic effects and evanescent waves in forming the photonic carpets.

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