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Subwavelength imaging of plasmonic nano-bubble cavity probed by Cathodoluminescence JUN XU, MIT, HYUNGJIN MA, UIUC, NICHOLAS FANG, MIT — Concentrating light into a deep-subwavelength volume is big challenge in conventional optics due to the diffraction limit. In recent years, plasmonics, the interaction of light and metallic nanostructures, offers new opportunities in manipulating light-matter interaction at a subwavelength scale. Because of a strong localized resonant response of the, the field can be confined in a plasmonic cavity with an ultra-small mode volume and a high Purcell factor. Plasmonic light sources at the nanoscale have been demonstrated by utilizing an active medium. However, such light sources are characterized based on either a diffraction-limited technique or a spatially-averaged lifetime measurement, neither of which show subwavelength information. Here, we present a method, cathodoluminescence (CL) that shows a subwavelength resolution image of nanoscale air bubbles trapped in between thin amorphous silicon and silver. A novel multiple-fringe pattern, with a strong dependence on the air gap width, is observed due to an enhanced luminescence. A simple model, based on an oscillating electric dipole, is applied to explain the phenomena. Both the plasmonic and conventional cavity effect of the light interacting with the novel nano-bubble system are considered. The plasmonic nano-bubbles may provide a new approach to generate localized light from a continuous thin film layer with high efficiency, for the application in ultra-compact optical device, molecular imaging, etc.

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