Anomalous infrared monochromatic transmission through superconducting structures

Oleg L. Berman, Vladimir S. Boyko, and Roman Ya. Kezerashvili

Physics Department, New York City College of Technology, the City University of New York,
Brooklyn, NY 11201, USA

Anomalous far infrared monochromatic transmission through a lattice of Abrikosov vortices in a type-II superconducting film is found and reported\(^1\). The transmitted frequency corresponds to the photonic mode localized by the defects of the Abrikosov lattice. These defects are formed by extra vortices placed out of the nodes of the ideal Abrikosov lattice. The extra vortices can be pinned by crystal lattice defects of a superconductor. The corresponding frequency is studied as a function of magnetic field and temperature in the framework of the Dirac-type two-band model. While our approach is valid for all type-II superconductors, the specific calculations have been performed for the \(\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}\) (YBCO). The control of the transmitted frequency by varying magnetic field and/or temperature is analyzed. It is suggested that found anomalously transmitted localized mode can be utilized in the far infrared monochromatic filters. Besides, anomalous infrared monochromatic transmission through a superconducting multiple conductor system consisting of parallel superconducting cylinders is found. The transmitted frequency corresponds to the localized photonic mode in the forbidden photonic band, when one superconducting cylinder is removed from the node of the ideal two-dimensional lattice of superconducting cylinders. The corresponding frequency was calculated for the \(\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}\) superconducting cylinders.