Experimental and simulation study of pinning phenomena in superconductors with regular composite pinning arrays

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Abstract

Pinning phenomena were investigated in the superconducting Nb thin film with composite hexagonal arrays. The composite pinning arrays were consisting of two kinds of pinning sites with different pinning sizes. The smaller pinning defects were added to the center of every honeycomb pinning array to observe the configuration of the vortices, comparing to the periodic triangular and honeycomb arrays. The film with this kind of composite array can be regarded as a transition between the films with triangular array and honeycomb array. The critical current as a function of magnetic field for four samples were measured. Regular 150 Oe interval of the matching fields for the triangular arrays was found, while for the honeycomb arrays, the interstitial vortices were caged at the center of every honeycomb array, causing 500e interval of the matching fields. For the samples with composite arrays, the 100 Oe or 50 Oe intervals of matching fields correspond to every larger or smaller pinning site capturing one more vortex, respectively. We found that the relative pinning strength of the large pinning sites is greater than that of the small ones. We conducted the simulations based on the time dependent Ginzburg-Landau theory to confirm that the interstitial

vortices did exist in the honeycomb arrays which caused the various intervals between the matching
fields.VC 2013 American Institute of Physics.

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