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Micromagnetic modeling of critical current oscillations in magnetic Josephson junctions

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Abstract

© 2016 American Physical Society.In this work we propose and explore an effective numerical approach for investigation of critical current dependence on applied magnetic field for magnetic Josephson junctions with in-plane magnetization orientation. This approach is based on micromagnetic simulation of the magnetization reversal process in the ferromagnetic layer with introduced internal magnetic stiffness and subsequent reconstruction of the critical current value using total flux or reconstructed actual phase difference distribution. The approach is flexible and shows good agreement with experimental data obtained on Josephson junctions with ferromagnetic barriers. Based on this approach we have obtained a critical current dependence on applied magnetic field for rectangular magnetic Josephson junctions with high size aspect ratio. We have shown that the rectangular magnetic Josephson junctions can be considered for application as an effective Josephson magnetic memory element with the value of critical current defined by the orientation of magnetic moment at zero magnetic field. An impact of shape magnetic anisotropy on critical current is revealed and discussed. Finally, we have considered a curling magnetic state in the ferromagnetic layer and demonstrated its impact on critical current.

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