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Break the acher's limit: improve both resonance frequency and initial permeability in patterned FeNi strip film

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ABSTRACT

The development of soft magnetic film materials gradually tends to pursue the higher resonance frequency which is beneficial to set the maximum operation speeds and lager permeability to make devices miniaturization. The studies on improving frequency have been widely reported. However, being restricted by the traditional Acher's limit, the research of simultaneously obtaining larger initial permeability and keeping higher frequency is still challenging. In this paper, the lamella-like (LL) magnetic strips with two types of line-widths are designed to align according to varied combined periods to form parallel shish-kebab-like structures (SKL). As the coercivity and remanence enhance, the outstanding in-plane uniaxial magnetic anisotropy is also investigated from 150 to 90 Oe when the unsymmetrical dipolar interaction is induced between two combined strips. In addition, the resonance frequency increases from 2.84 to 7 GHz and still sustains the same value after being assembled with the different periodic units. Meanwhile, the initial permeability also keeps a higher value around 85 compared to the value of 15 before combination, which breaks through the Acher's limit. Therefore the method of tunable magnetic properties by introducing the shape factor and dipolar interaction together has a great potential research value in high-frequency soft magnetic film fields.