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Domain wall oscillation in magnetic nanowire with a geometrically confined region

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Abstract – In conventional magnetic devices such as magnetic tunnel junctions, a steady oscillation of a soft layer magnetization could find its application in various electronic systems. However, these devices suffer from their low output signal and large spectral linewidth. A more elegant scheme based on domain wall oscillation could be a solution to these issues if DW dynamics could be controlled precisely in space and time. In fact, in DW devices, the magnetic configuration of domain wall and its position are strongly dependent on the device geometry and material properties. Here we show that in a constricted device with judiciously adjusted dimensions, a DW can be trapped within the central part and keep oscillating with a single frequency $f$. For 200 nm by 40 nm nanowire, $f$ was found to vary from 2 GHz to 3 GHz for a current density between $4.8 \times 10^{12}$ A/m$^2$ and $5.6 \times 10^{12}$ A/m$^2$. More interestingly, the device fabrication is simply based on two long nanowires connected by adjusting the offset in both $x$ and $y$ directions. This new type of devices enables the conversion of dc- current to an ac- voltage in a controllable manner opening thus the possibility of a new nano-oscillators with better performance.

1. Introduction

The reversal and oscillation of the magnetization of a ferromagnet by a spin transfer torque (STT) effect is of important interest to both academic and technology researchers. Reversing the magnetization by STT without magnetic field is crucial in scaling down the devices size such as magnetic random memory (MRAM) [1–16]. The device is a magnetic tunnel junction (MTJ) composed mainly of a soft magnetic
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