The effect of gap distance on soliton propagation in a ferromagnetically coupled nanodisk chain

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Magnetic single-domain nanodisk chain has the potential for information propagation media [1]. In the magnetic nanodisk chain, the propagation speed of soliton of magnetization has been predicted to reach around 1 km/s at high field regime [2]. In the discrete chain, each disk interacts with neighboring magnetic disk via dipolar interaction. Change of magnetization state of one magnetic disk initiates the change of magnetization of neighboring magnetic disks. Therefore, dipolar interaction plays a key role in the soliton propagation. Usually, dipolar interaction depends on the saturation magnetization of magnetic disk and the gap distance between the magnetic disks. One of big advantageous features of discrete media is the individual control of magnetic disk shape and inter-disk gap distance. Here, we have studied how the gap distance can affect the propagation speed of soliton in the discrete magnetization system. For this purpose, we have carried out micromagnetic simulation using OOMMF [3]. Once a head-to-head or tail-to-tail magnetization soliton is formed in the chain by utilizing fixed magnetic disk and external bias field, external pulse field can drive the motion of the soliton along the chain in one direction. By fitting the trajectory of the position of soliton, we could obtain the propagation speed in a given external pulse field and gap distance. We used the disk diameter of 90 nm, the saturation magnetization of 800 emu/cc, and damping parameter of 0.008. Figure 1 shows the disk chain and the propagation of soliton along the chain. Figure 2 shows the plot of the propagation speed as a function of gap distance. As the gap distance increases, speed increases. This could be understood that strong dipolar field has a quenching effect on the propagation speed if the external pulse fields are same.

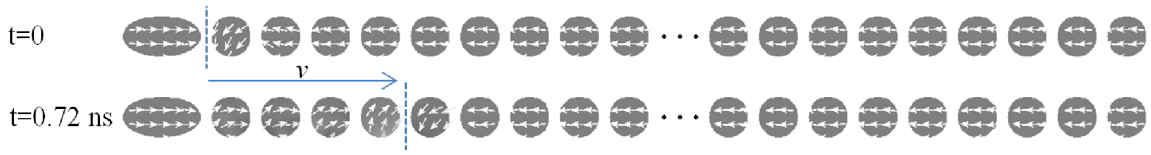

Fig 1. The calculated soliton propagation under the action of a 7-mT field on a 32-magnetic-disk chain from left to right.

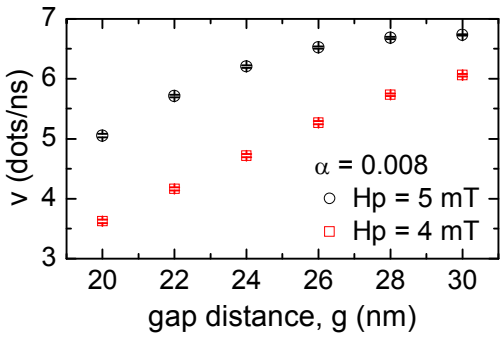

Fig 2. The calculated propagation speed of the soliton as a function of gap distance. The symbol of short horizontal line indicates the error bar.

References

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