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Gilbert Damping Mechanisms in Half-metallic Heusler Alloys[1]

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Manipulation of fast magnetization dynamics is crucial for spintronics devices, such as magnetic random access memory with spin-transfer torque switching or spin-transfer torque oscillator. Especially, Gilbert damping is one of the important factors for reducing current density required in the devices. Half-metallic Heusler alloy is one of the promising materials for device electrodes because it exhibits not only large magnetoresistance but also small Gilbert damping [1,2]. According to our previous studies, Gilbert damping for Heusler alloys depends on atomic ordering [1,3,4] and composition [5], and there seems to be a correlation between Gilbert damping and total valence electron number in B2 or $L2_1$ ordered Heusler alloys [4,5]. Although Gilbert damping mechanisms are still open questions, our results imply that Gilbert damping is related to not only spin-orbit interaction but also density of states at Fermi level because it is well known that the density of states at Fermi level in Heusler alloy varies systematically with total valence electron number. In this talk, we present the overview of our previous results on Gilbert damping for Heusler alloys (Co_2MnSi, Co_2MnAl, Co_2FeAl, Co_2FeSi), the recent results on the composition dependence and temperature dependence of Gilbert damping for quaternary Co-based full Heusler alloys ($Co_2Mn_{1-x}Fe_xSi$ and $Co_2MnAl_{1-x}Si_x$), and a discussion of possible mechanisms.

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