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Enhancing spin transfer torques in magnetic tunnel junctions by ac modulation[1] XIAOBIN CHEN, McGill University and the University of Hong Kong, CHENYI ZHOU, McGill University, ZHAOHUI ZHANG, University of Manitoba, JINGZHE CHEN, Shanghai University, XIAOHONG ZHENG, LEI ZHANG, McGill University, CAN-MING HU, University of Manitoba, HONG GUO, McGill University — Phenomena of spin transfer torques (STTs) have been attracting persistent interests due to promising prospects of STTs in designing nano devices. By using nonequilibrium Green's function method, we derive time-averaged formulism for spin transfer torques in a noncollinear magnetic tunneling system under ac modulation. Using these formulas, we further investigate ac spin transfer torques in a carbon-nanotube-based magnetic tunneling system. It shows that under ac modulation, the low-bias linear (quadratic) dependence of the in-plane (out-of-plane) torque on bias still holds, and the $\sin\theta$ dependence on noncollinear angle is maintained. By introducing photon-assisted tunneling, the bias-induced components of the in-plane and out-of-plane torques can be enhanced by about 12 and 75 times, respectively. Further analysis shows that optimized enhancement can be achieved by using ac driving frequency $\omega = \epsilon_0/k, k = 1, 2, ...$, where ϵ_0 marks a remote dc transmission peak, and ac amplitude Δ such that Δ/ω maximizes a k^{th}-order Bessel function. Our findings suggest that ac modulation is an effective way for electrical manipulation of STTs, paving the road towards emerging STTs-based nanoelectronics and spintronics.

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