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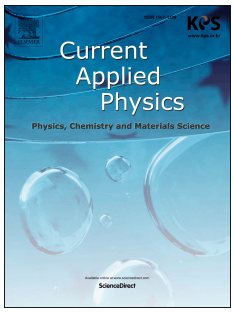

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Spin-Transfer-Torque-Induced Zero-Field Microwave Oscillator Using a Magnetic Easy Cone State

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Abstract

Current-induced spin-transfer torque can induce magnetization precession in gigahertz ranges, which enables various microwave devices. In most cases, this current-induced precession requires an additional external magnetic field, which is detrimental for device applications. In this work, we show that the current-induced precession is realized even without an external field when the magnetic layer has conical magnetization, caused by the second order easy-axis magnetic anisotropy. We theoretically derive the oscillation frequency and output power and confirm their validity by macrospin simulations. We find that the ratio of the second to the first anisotropy constants is key to determine the maximum frequency and power. Our results will be helpful for the applications of microwave devices utilizing spin-transfer torques and provide a design rule of such devices.