Phase locking of multiple spin-torque nano oscillators

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Spin-torque nano-oscillator (STNO) is based on the transfer of spin angular momentum to the local magnetization of nano-magnetic structures, which generates a microwave signal under certain conditions of external magnetic field and DC current [1]. The STNO raises prospects for a microwave generator, but critical disadvantages such as lower power and broad linewidth hinders the real applications of STNO for wireless communications [2]. The synchronization of multiple STNOs is one of solutions to overcome those disadvantages [3].

Here, we have studied the phase locking of multiple STNOs consisting of nano-scale magnetic tunnel junctions by injecting an external microwave signal. The microwave response of an STNO, which shows a broad oscillation peak at 3.1 GHz, is measured with increasing the power of the external microwave signal (P_{ex}). The broad response of the peak is unchanged when P_{ex} is small, gradually decreased from P_{ex} = -25 dBm, and almost disappeared at P_{ex} = -10 dBm. This indicates that the oscillation of the STNO is locked to the injected external signal. As the frequency of external signal is varied from 1.5 to 8.3 GHz, the injection locking is observed in a wide range of frequency from 1.8 GHz to 2.7 GHz. Next we have investigated the injection locking of two STNOs connected in parallel, which show two distinguished oscillation peaks at 2.0 and 3.1 GHz, respectively. The phase locking of two STNOs to the injected external signal is observed in an unexpectedly wider range of frequency. This wide-range phase locking of multiple spin-torque nano oscillators will be extremely useful for constructing microwave transceivers for wireless communications.

References

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