MICROWAVE GENERATION IN NANOPILLARS INDUCED BY A SPIN TRANSFER TORQUE: A NEW PARADIGM OF HIGH FREQUENCY OSCILLATORS

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STNOs (Spin Transfer NanOscillators) are non-linear oscillators [1,2]. The study of their dynamics implies new problems and new physics. The characteristics of STNOs in terms of integration and agility are very promising for applications in next generation telecommunication devices. In view of the state of the art, two main problems have first to be adressed : the large applied field and the very low emitted power.

First, I will show that in nanopillars with specific magnetic stacks, microwave emission might be generated without any applied field. This is obtained by tuning the angular dependence of the spin torque through the choice of appropriate spin dependent transport parameters. This results into a cancellation of the torque at an angle φc (different from 0 or π) leading to sustain magnetization oscillations at zero (or very low) field. I will show some recent experimental results for which we have performed transport and high frequency measurements on 'wavy' nanopillars [3]. These experiments not only represent a good test of the theoretical models of spin transfer but also open an interesting path for spin transfer oscillators without the need of applying a magnetic field.

In the second part, I will adress the question of the enhancement of the output power since the emitted power by a single STO (nanopillar or nanocontact) is far too weak (of the order of a few pW). The only solution to overcome this problem is to achieve the synchronization of an assembly of STOs, that should result in an increase the output power and a decrease the linewidth of the emitted signals [4,5,6].We have recently proposed a scheme for synchronization of several STOs by connecting them in series or parallel [6]. Furthermore, in order to investigate the prerequisites to lock-in of large networks of STOs, we have studied the phase locking of a single STO with an external microwave source in various conditions of applied field and dc current. From the analysis, we can correlate the locking efficiency with the intrinsic characteristics of the STO : linewidth, emitted power, agility of the free-running oscillations. The collected informations allow us to propose some optimized conditions needed for successful synchronization through the stimulated microwave current of a large amount of STOs [7].

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