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Electromechanical instabilities of suspended carbon nanotubes - multi mode excitations MAGNUS JONSSON, LEONID GORELIK, Department of Applied Physics, Chalmers University of Techology, SE-412 96 Gothenburg, ROBERT SHEKHTER, MATS JONSON, Department of Physics, Goteborg University, SE-412 96 Gothenburg — We have theoretically investigated electromechanical instabilities of suspended carbon nanotubes when using an STM-tip to probe the suspended part of the tube. A coupling between the vibrational modes of the nanotube and tunneling electrons may lead to a pumping of energy into the mechanical subsystem, resulting in large amplitude vibrations of the CNT. This effect is related to the "shuttle instability" and changes the transport properties of the system. In the present study, instability of different bending modes have been investigated. We show that, with respect to the instability, different modes can be treated independently in the limit of weak electromechanical coupling. Also, we show that excitations of different modes are controlled by their vibration frequency and tunneling rates. Tunneling rates of the order of the frequency are found optimal for an instability to occur. Hence, a selective excitation of a single mode is possible. We analyze the limit cycle behavior in this case. Another scenario is simultaneous excitation of several modes, leading to a complex behavior in stationary regime.

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