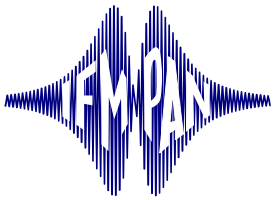

Instytut Fizyki Molekularnej

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Rozprawa doktorska

Fale spinowe w strukturyzowanych warstwach permaloju tworzących periodyczne, kwaziperiodyczne nanostruktury magnoniczne oraz falowody

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Abstract

Spin waves, i.e. the collective excitations of spins, are listed as a potential alternative to electron transport in the process of information transfer. In addition, the structuring of magnetic materials contributes to the modification of the magnonic band structure, which determines the possibility of manipulation and control of spin waves. Magnonic systems using spin waves could offer many advantages, such as high operational frequencies (in the GHz – THz range), the possibility of significant miniaturization, or the possibility of using amplitude or phase of spin waves, which could lead to more efficient and energy-saving systems. In order to achieve this, several challenges have to be faced, among which important are selecting the right material and geometry of the structures or developing efficient ways of excitation of short spin waves using emitters of nanometer scale. These two issues are the subject of this thesis. Within the first of them, one-dimensional magnonic quasi-crystals composed of networks of stripes arranged quasiperiodically according to the concept of the Fibonacci sequence were studied. The influence of quasiperiodicity on the process of remagnetization of the stripes array and the presence of the preferences in the order of the remagnetization of the stripes were explained. Moreover, the dispersion relations were determined for two magnetization configurations - ferromagnetic and antiferromagnetic. Additionally, the possibility of reprogrammability of the system using the shift of bands when changing its configuration was presented. Using the imaging of the magnetic excitations, the possibility of spin waves propagation in this kind of systems was shown. The spin waves disappearance was also observed, caused by the band gaps as well as mini-band gaps, arising due to the quasiperiodicity of the system. The systems of two different types of stripes width was investigated and the preservation of their properties was shown, thus demonstrating the scalability of the system. These studies suggest the possibility of potential applications of quasiperiodic structures in magnonic devices and show

their properties, exceeding those present in the periodic systems. The second issue addressed in this thesis concerned the excitation of short spin waves (of the wavelength even below 100 nm) in the rectangular waveguides and beams of the spin waves in the antidots lattices. It was determined that the source of these waves is connected with the edges of the structures (waveguide edge or the antidots edges), causing the occurrence of the non-uniformity of magnetization.