

Analysis of electron spin resonance of LiCu_2O_2 at low temperature

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In LiCu_2O_2 , which is a multiferroic material, there are competing superexchange interaction in spin chains and the ground state has spiral spin configuration. In ESR¹ there are resonances at $\nu_1 \sim 30\text{GHz}$ and $\nu_2 \sim 300\text{GHz}$. The former does not appear in the spectrum of NaCu_2O_2 which has similar structure but is not multiferroics.

We consider a zigzag spin chain with competing nearest and next nearest superexchange interactions. Additionally, we considered anisotropic exchange interaction and Dzyaloshinskii-Moriya(DM) interaction perpendicular to the spiral plane. Based on the classical picture and spin wave theory, we calculate the low lying excitations. We found that the resonance ν_1 corresponds to the spin wave state of wave vector $|q| = Q$ where $\vec{Q} = (0.5, 0.174, 0)$ is the wave vector of spiral spins. Both DM interaction and superexchange anisotropy can be the mechanism for resonance. For H parallel to the spiral axis, there are two branches. For H perpendicular to the spiral axis, we found only one branch. By comparing with experiment result, the system properties, such as anisotropy and DM interaction can be revealed. We are also going to analyze the line shape by calculating the energy dissipation of the system. Based on this work, one should be able to identify the basic difference between LiCu_2O_2 and NaCu_2O_2 .

¹L. E. Svistov, et. al., J. Phys.: Conf. Series 200, 022062 (2010)