MAGNON ASSISTED LONG-RANGE SUPERCONDUCTING PROXIMITY EFFECT IN HALF-METALLIC FERROMAGNETS

J. Martinek\textsuperscript{a}, G. Ilnicki\textsuperscript{a}, S. Takahashi\textsuperscript{b}, S. Hikino\textsuperscript{c}, M. Mori\textsuperscript{c}, and S. Maekawa\textsuperscript{c}

\textsuperscript{a}Institute of Molecular Physics, Polish Academy of Sciences, 60-179 Poznań, Poland
\textsuperscript{b}Institute for Materials Research, Tohoku University, Sendai 980-8577, Japan
\textsuperscript{c}Advanced Science Research Center, Japan Atomic Energy Agency, Tokai, Japan

Recent experiments demonstrate that even in the half-metallic fully-spin-polarized ferromagnets a long-range proximity effect is possible as in normal metals. We consider that at an interface the conversion between singlet pair and triplet one is assisted by a creation of magnon excitation. Such a triplet pair can penetrate the ferromagnet for a long distance while a singlet one cannot. Considering the thermal Bose distribution of magnons we obtain, due to destructive interference between magnons of different momentum, a short range proximity effect. We find that, in the case when a single magnon mode dominates other modes, the long-range proximity effect is possible as well. We suggest two possible scenarios in order to create a single mode behavior. First, via nonequilibrium magnons injected during the coherent precession of the magnetization by tuning the microwave frequency to the ferromagnetic resonance (FMR) frequency in a ferromagnetic Josephson junction. In the second scenario, we consider Bose-Einstein condensation (BEC) of magnons induces by the increase of the magnon chemical potential due to the superconducting proximity free energy. The BEC of magnons will induce a modulation of magnetic order (the inverse proximity effect) - spin superstructure presumably with a weak helical structure that allows for dissipationless spin current.

Subject category:
3. Magnetic Structure and Dynamics

Presentation mode:
oral

Corresponding author:
Jan Martinek

Address for correspondence:
Institute of Molecular Physics,
Polish Academy of Sciences,
ul. Smoluchowskiego 17, 60-179 Poznań

Email address:
martinek@ifmpan.poznan.pl