Packed powder as superleak for spin pump experiments in superfluid ^{3}He A_1

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Experimental exploration of highly spin-polarized states of liquid ^{3}He by applying external magnetic field is limited by available static magnetic field. In the "ferromagnetic" superfluid A_1 phase of liquid ^{3}He there is an alternate method for boosting spin-polarization by the process of spin pumping[1] without requiring such high magnetic field. The spin pumping in the A_1 phase take advantage of a superleak (SL) acting simultaneously as a filter for both entropy and spin. The spin pump technique that uses the SL-spin filter and a mechanical actuator enables us to directly boost polarization of ^{3}He. The amount of enhancement is spin-polarization has been limited[1] so far. We are now developing a new-type of SL filter made of packed aluminum oxide powder (referred as PAP-SL), in order to achieve greater enhancement of spin polarization. Several kinds of the PAP-SL filter were constructed by pressing aluminum oxide powders into a cylinder holder. The packed powder structures were carefully characterized by a flow-rate-measurement, X-ray tomography, and mercury intrusion porosimetry. The preliminary result shows that the PAP-SL works as SL filter for the superfluid ^{3}He, but the critical current is strongly suppressed compared to a regular cylinder SL filter.

1. A. Yamaguchi, Y. Aoki, S. Murakawa, H. Ishimoto, and H. Kojima, Phys. Rev. B 80, 052507 (2009).

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