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PrF₃ Van Vleck paramagnet as a promising material for the nuclear dynamic polarization of ³He

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Abstract

We suggest using insulating Van Vleck paramagnet PrF₃ as a solid substrate for the dynamic polarization of ³He nuclei at high magnetic fields. The exploring of solid effect for this purpose assumes the knowledge of the optimal conditions for transfer of polarization from the Pr³⁺ electron shell in PrF₃ to ¹⁴¹Pr nuclear spins as well as the existence of effective channel for magnetization transfer from ¹⁴¹Pr nuclear spins to nuclear spins of liquid ³He (so-called magnetic coupling phenomenon). To study solid effect in PrF₃ the magnetic field dependencies of the Stark energy levels of ³He ground state multiple were calculated for high magnetic fields up to 40 T using the set of crystal-field parameters obtained early from magnetization measurements and exchange charges model. Also the results of searching for a direct magnetic coupling between nuclei of the liquid ³He and ¹⁴¹Pr nuclei in the system "PrF₃ powder - liquid ³He" by pulse NMR method are represented. Also the surface effects in the PrF₃ crystal were studied by SQUID and optical microscopy measurements. Other aspects of the nuclear polarization transfer are discussed. © 2006 IOP Publishing Ltd.

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