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Dynamic Nuclear Polarization using short-lived photo-excited triplet states: experiments and applications

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In DNP experiments the high polarization of an electronic spin system is transferred by suitable microwave irradiation to the nuclear spin system. In usual classical schemes ground state paramagnetic centers are introduced into the sample as dopants and their electron spin polarization is determined thermally. This requires temperatures of 1K or lower and a magnetic field of several Tesla. As an alternative, short-lived photo-excited triplet states are highly polarized independent of temperature and field. But classical DNP, driven by weak cw microwave irradiation is too slow and one has to resort to pulsed DNP using strong microwave fields. During the last years we have pushed the development of "triplet DNP"in view of applications in neutron scattering. By optimizing several crucial parameters, proton polarization values of above 70% are now routinely achieved in naphthalene single crystals doped with pentacene at a field of 0.36 T at about 40 K. We have demonstrated that triplet DNP is well suited to build a neutron spin filter, e.g. to perform polarization analysis in small angle neutron scattering in a magnetic field.

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