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Optimization of Potassium-Rubidium hybrid optical pumping spin-exchange relaxation-free Magnetometer[1] TAO WANG, JIANCHENG FANG, Beihang University, HONG ZHANG, Southeast University, YANG LI, Beihang University, SHENG ZOU, Southeast University, WEI QUAN, HENG YUAN, Beihang University, SCHOOL OF INSTRUMENT SCIENCE AND OPTO-ELECTRONICS ENGINEERING COLLABORATION — The spin-exchange relaxation-free (SERF) magnetometer has obtained ultra-high sensitivity, which is benefited from the totally suppression of the spin-exchange relaxation. However, it is difficult to keep the alkali atoms illuminating by pumping beam with uniform pumping rate through the cell, which causes the nonuniform light shift. A SERF magnetometer with hybrid optical pumping technology was proposed in this paper, which can highly reduce the optical depth of the pump beam due to lower density of potassium gas for optical pumping. A simulation of probe beam's optical rotation with the wavelength of the probe beam was demonstrated, which matched well with the experiments, and the largest optical rotation is obtained. Benefiting from the thin optical depth, the pump beam can be exactly tuned to the D1 line. Furthermore, the optimization of the probe beam's power was proposed. When the pumping rate of the probe beam equals the spin-destruction rate, the magnetometer obtains best sensitivity. The magnetometer's linewidth was measured by using the synchronous optical pumping method. The spin-destruction rate can be calculated by the linewidth. Then, a simulation of the pump beam's pumping rate was demonstrated, the pump beam's power was optimized to achieve best sensitivity.

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