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Realization of an advanced broadband supermirror solid-state neutron polarizer for fundamental physics applications

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For many experiments performed at the cold-neutrons fundamental physics instrument PF1B at ILL, the polarizer is an essential component [1]. Placed after the guide exit, it should produce a large-area, intense and well polarized "white"beam spanning a broad wavelength range (from 0.2 to 2.0nm). Until recently, a "Schaërpf-type"bender based on Co/Ti supermirrors was used, showing 98.5% polarization efficiency and about 50% transmission of "good" spin component. For higher polarization, the "crossed configuration" [2] could be used, yielding 99.7% polarization and 25% transmission. After more than 15 years of successful exploitation, the polarizer showed significant Co activation and noticeable damage of the mirrors. The present project aims at replacing the polarizer with a new one, having less operational drawbacks. The concept [3] is a more compact solid-state "V-bender", based on Fe/Si supermirrors deposited in-house on sapphire substrates. Special care was taken to limit depolarization effects [4] and to minimize angular misalignments when stacking the mirrors. Following the concept validation with the first prototypes and measurements [5], the realization of the record-breaking [6] final device [7] will be described, including fabrication, neutron characterization preceding final installation on PF1B, and possibilities to extend the concept to other cases.
1. E.g. D. Mund & al, Phys Rev Lett 110, 172502(2013)
2. M. Kreuz & al, Nucl lnstr Meth A547, 583(2005)
3. A.K. Petukhov & al, Nucl lnstr Meth A838, 33(2016)
4. C. Klauser & al, Nucl Instr Meth A840, 181(2016)
5. A. K. Petukhov & al, Rev Sci Instr 90, 085112(2019); presentation ECNS 2019
6. ILL Annual Report 2020, p.78
7. A. K. Petoukhov & al, ArXiv2208.14305(2022)

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