Very Cold Neutron Moderators at LENS

Low Energy Neutron Source

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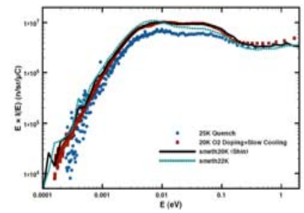


Abstract

A major goal for the LENS facility is the development of neutron moderators that can deliver neutron beams with spectral temperatures below that available at other sources. Recently interest has been growing within the neutron scattering community in the idea of a very cold neutron source. Such a source would have a spectral peak at wavelengths on the order of 2.0nm and useful neutron flux out to on the order of 10nm. Such a source is attractive for a wide variety of applications in areas ranging from fundamental physics to quasielastic scattering. Neutron optical elements such as guides and lenses work more effectively at long wavelengths and therefore a VCN source may also open opportunities for applying neutron techniques to smaller samples. Consequently , both ISIS and the SNS are allowing for possible future installation of VCN moderators in the desings of their respective second target stations. LENS is in a unique position to take a leading role in the development of such moderators since the its moderators experience very little thermal loading (less than a few watts even at 10kW of proton beam power) when compared to existing spallation sources where moderator systems may have to dissipate several kW. In this poster we describe our efforts to date in characterizing and understanding the LENS moderator. This has produced some tools and ideas that will be employed in the future in our efforts to reduce the spectral temperature of the neutrons produced at LENS to below 10K.

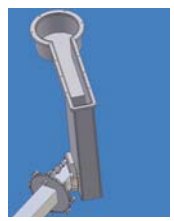
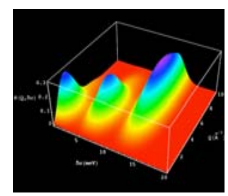
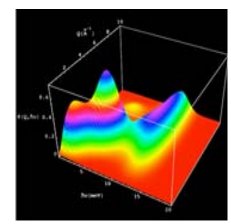
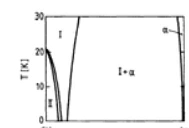


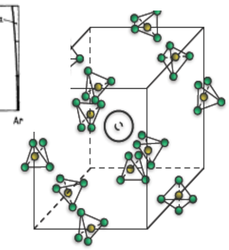
Figure 4 The SANS beam line will be used to characterize the spectra and emission time distributions from candidate moderators, and to perform total cross section measurements of candidate materials (such as alloys of methane and argon or ethane, deuterated materials etc.).

Figure 3 The expected relative count rate expected in the SANS instrument for a hard-sphere sample with a diameter of 6.0 nm. We note that for SANS samples such as these, where statistical uncertainty at the lowest Q determines the data collection time, lowering the moderator spectra temperature from 30 K to 15K would reduce data collection times by a factor of more than 3 as indicated in Figure 3 to the right.









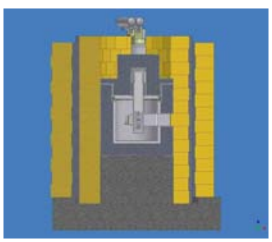


Figure 1 The essential features in the LENS Target Moderator Reflector (TMR) assembly are a Be target, a 50cmx50cm cylindrical water reflector, and a 1-cm thick solid methane moderator. The moderator is cooled by a closed-cycle He refrigerator to which it is linked by a 99.999% pure aluminum bar. When operating at 10kW beam power, we anticipate a thermal load of less than 300 mW on the second stage of the refrigerator. We can operate the moderator at temperatures below 6K with this load.

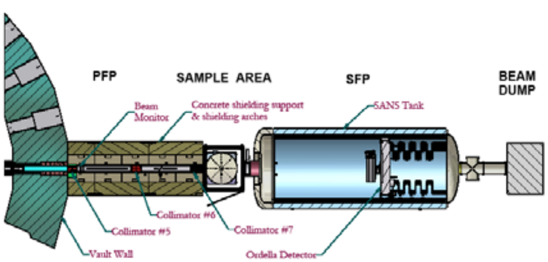
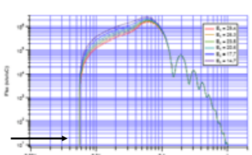


Figure 2 The SANS beam line will be used to characterize the spectra and emission time distributions from candidate moderators, and to perform total cross section measurements of candidate materials (such as alloys of methane and argon or ethane, deuterated materials etc.).

Figure 3 The expected relative count rate expected in the SANS instrument for a hard-sphere sample with a diameter of 6.0 nm. We note that for SANS samples such as these, where statistical uncertainty at the lowest Q determines the data collection time, lowering the moderator spectra temperature from 30 K to 15K would reduce data collection times by a factor of more than 3 as indicated in Figure 3 to the right.



Conclusions

The LENS facility is uniquely positioned to make significant contributions in the field of Very Cold Neutron production. We have initiated an effort in this field by demonstrating our abilities to run moderators at temperatures well below 10K, to modify the neutronic details of the TMR to tune the spectrum, and to develop MCNP scattering kernels suitable for modeling the neutronic performance of real moderator materials. Future work will include the effects of annealing on moderator performance and investigation of a wider variety of candidate materials as well as characterization of moderator system performance at higher power levels.

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