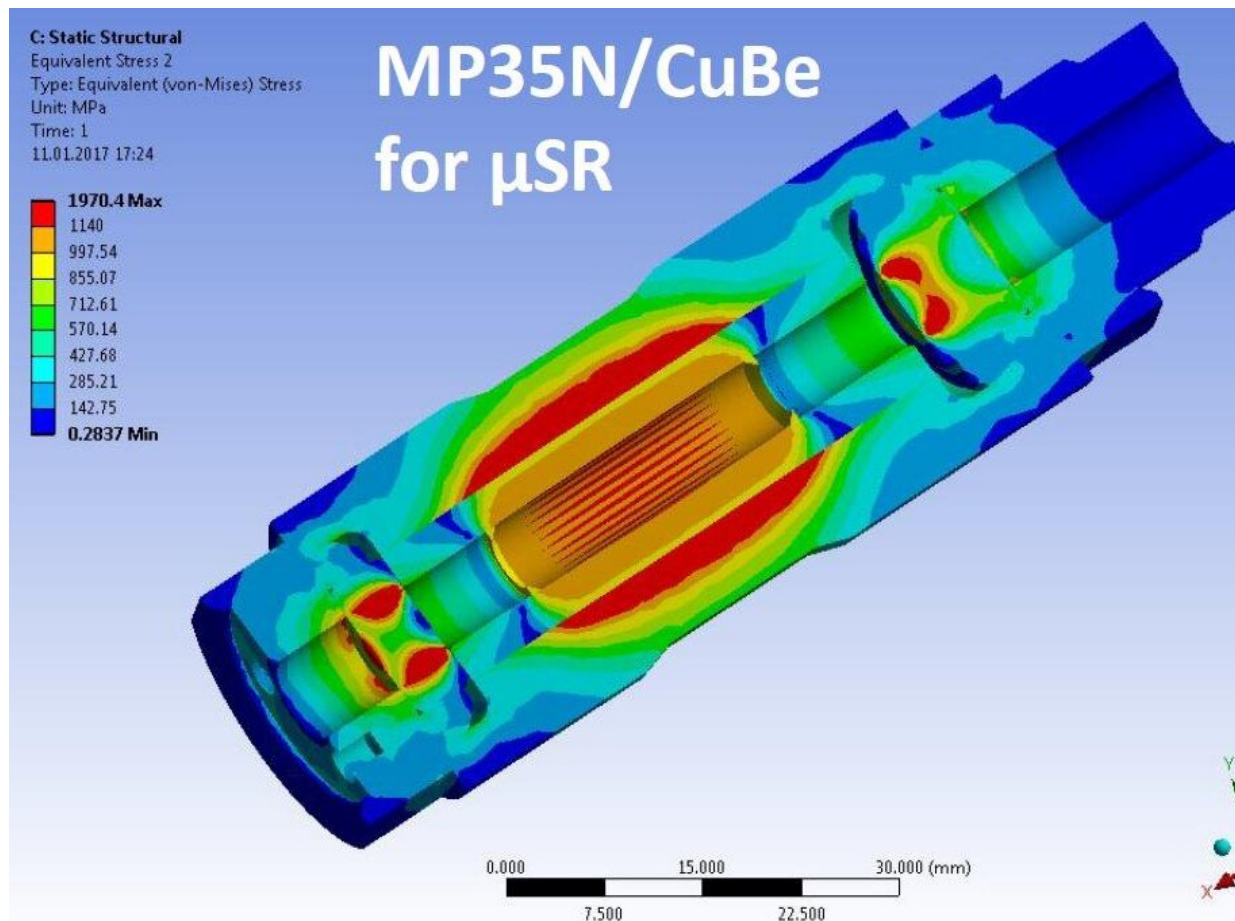


Improving a piston-cylinder pressure cell for μ SR experiments

September 20 2019



Credit: PSI/SINE2020

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at PSI have looked at the design of a double-wall piston-cylinder pressure cell specifically designed for muon-spin rotation (μ SR) experiments.

The first step was to make both the inner and outer cylinders of a double-wall pressure cell design out of Copper Beryllium (CuBe), a common alloy used for μ SR pressure [cells](#). This material has well-defined low-background contributions to the μ SR signal that are almost temperature-independent and therefore favorable for use in low-temperature μ SR studies. The [mechanical characteristics](#) were then analyzed using the finite-element analysis (FEA) software ANSYS which allowed optimization of the cell dimensions to try and reach the highest possible pressure whilst keeping experiments safe.

A prototype was built which allowed a pressure of about 18 kbar, in agreement with the ANSYS simulations, but after a third consecutive pressure application, the outer [cylinder](#) broke as the stresses accumulated within it.

To improve the design, a second prototype was constructed using another nonmagnetic alloy commonly used for μ SR pressure cells: MP35N. This material was used for the outer cylinder instead of the CuBe. Tests revealed that pressures of ~ 2.6 GPa could be reached without any irreversible damage of the cell. Luckily, as the muons mainly stop in the CuBe inner cylinder during experiments there was still a low-background SR signal despite the change in material of the outer cylinder.

The work has now been published in the Journal of High Pressure Research and μ SR users now have access to a piston cell for μ SR techniques that reaches pressures 1.5 times higher than previously possible.

Provided by CORDIS

Citation: Improving a piston-cylinder pressure cell for μ SR experiments (2019, September 20)
retrieved 25 April 2024 from

<https://phys.org/news/2019-09-piston-cylinder-pressure-cell-sr.html>

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