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Magn. Reson. Discuss., referee comment RC2
https://doi.org/10.5194/mr-2022-15-RC2, 2022

Comment on mr-2022-15

Vasyl Denysenkov (Referee)

Referee comment on "Electroplated waveguides to enhance DNP and EPR spectra of silicon and diamond particles" by Aaron Himmler et al., Magn. Reson. Discuss., https://doi.org/10.5194/mr-2022-15-RC2, 2022

The manuscript by Aaron Himmler et al. describes improved performance of the high field EPR/DNP spectrometer designed for experiments at low temperatures.

The improvement is achieved by reduction of microwave transmission losses in an oversized stainless steel waveguide by coating its inner surface with a thin layer of silver as a high conductivity metal with respect to stainless steel. The manuscript contains a detailed illustration of the probe design, schematic setup for measuring transmission losses, as well as an electroplating method that is simple enough to be accomplished in a lab. Measurements of EPR spectra show clear improvement in the case of silver-plated waveguide with respect to the stainless steel waveguide case.
The present results can be interesting for the magnetic resonance community. The manuscript is clearly written and can be suited for publication after corrections.

I just have some questions:

Line34: it is stated that the “favorable corrugated waveguides are challenging to combine with a low temperature DNP cryostat”. But, there are some successful examples in the referred literature describing EPR and DNP spectrometers with low temperature probeheads equipped with custom-tailored corrugated waveguides manufactured by Thomas Keating Ltd (UK) with very low transmission losses (0.1 dB/m) at frequencies above 180 GHz. Moreover, EPR/ENDOR probeheads (also equipped with a corrugated waveguide and compatible with Oxford Spectrostat) of the Bruker E-780 spectrometer operating at 263 GHz are commercially available on the market. Frame of the probehead could be suitable with your setup after minor change in the taper. Besides, some corrugated waveguides fabricated by GYCOM Ltd (Russia) which are made of German silver can also be a cheap option in case of a very limited budget. Please justify your choice more clearly.

Line 103: "inner surface of the waveguide was first abrasively polished… then degreased with a water-based degreaser… ". Typically, stainless steel has a poor adhesion with electroplated metal layers such gold, silver, or copper, especially if the surface was not etched preliminary. It is not clear from the text how adhesion issue is fixed. Does the water-based degreaser work also as an etching agent, or do you accomplish an etching step before silver deposition additionally? If not, please comment on the adhesion issue.

Line 156: "…in attenuation, namely 1.2 dB/m to 1.1 dB/m at 197 GHz…" The values look appropriate. However, oversized waveguides can transmit higher order modes beside the fundamental mode causing some standing waves along the oversized waveguide with tapers on both sides: the larger waveguide aperture the more propagating modes causing more standing waves. Presence of these standing waves can deteriorate performance of the waveguide at certain frequencies. It can be estimated by measuring transmission losses in the frequency range of interest, namely in the range from 196.7 GHz to 197.7 GHz in your case. Please add a transmission loss versus frequency plot to see how good is performance of the waveguide in the full frequency range.