PROGRESS OF MgB_2 DEPOSITION TECHNIQUE FOR SRF CAVITIES AT LANL

P. Pizzol, A. Poudel, I. Nekrashevich, L. Civale, H. Salazar, D. Kelly, R. K. Schulze, T. Tajima, Los Alamos National Laboratory, Los Alamos, NM 87545, USA

Introduction

Problems

- Niobium cavities approaching theoretical limit
- Niobium raw material cost increasing
- Cryoplant required to cool down SRF Nb with superfluid He

Solutions

- Alternative materials:
  - Nb_3Sn
  - MgB_2 = 38 K T_c

Experimental

Deposition system

Samples obtained via two stages process:

1. Boron deposition – copper cavity inserted in tubular furnace with samples attached to it
2. Mg evaporation – samples removed from cavity and placed in small tubular furnace with Mg pellet

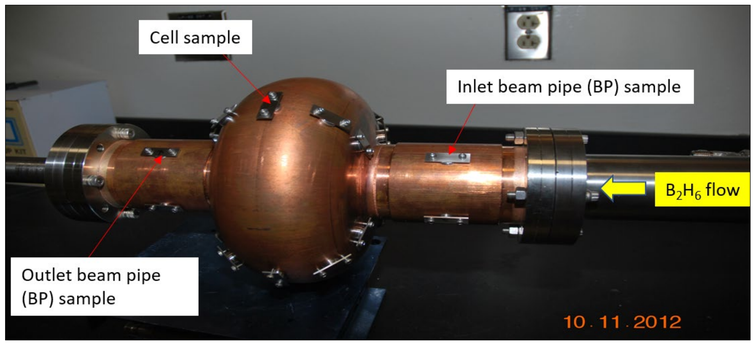

Figure: Cavity used to obtain B coatings on flat samples during a project that ended in 2015

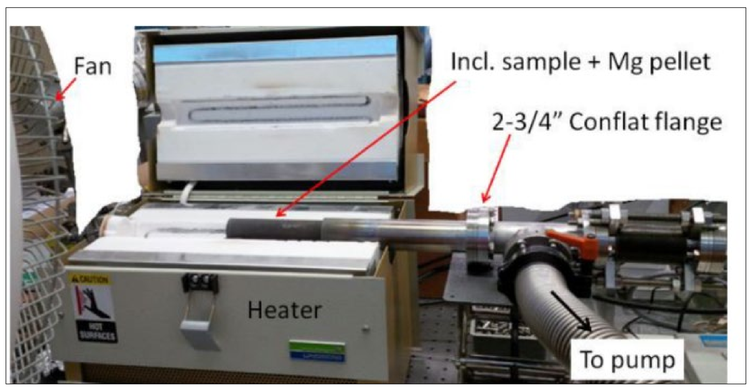

Figure: A small tubular furnace used for B and Mg reaction experiments.

Fast vs. Slow Cooling

Mg evaporation tests have been performed with a fast cooling step until now to prevent decomposition of formed MgB_2.
To simulate the behavior of the new full-scale coating system, slow cooling was attempted.

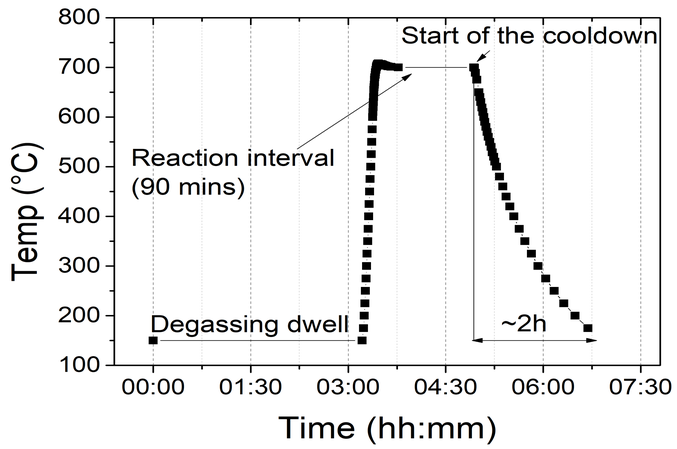

Table: Tc of samples obtained at slow and fast cooling

Position	Slow cooling T_c	Fast cooling T_c
Cell	35.6 K	35.3 K
Outlet	37.9 K	
Inlet		38.0 K

Samples obtained with slow or fast cooling show very similar T_c
Slow cooling is possible as long as Mg/B >1/2 during cool down.

Chemical composition

- Chemical compositions show oxygen in all samples
  - Possible explanation of lower than theoretical T_c
- Stoichiometry of sample grown at outlet is closer to theoretical composition of MgB_2 than stoichiometry of sample grown on the cell (1:2 vs 1:2.4)
  - Another possible reason for lower than theoretical T_c
- Overall both samples show stoichiometry close to MgB_2, although further studies are needed to fine tune the deposition parameters.

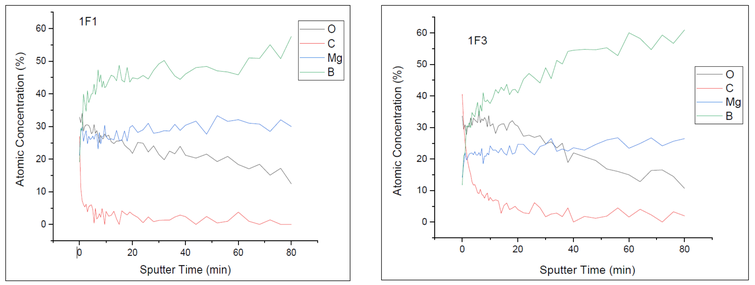

Figure: XPS of outlet (left) and cell (right) samples obtained at 700 °C and slow cooled

New Coating System

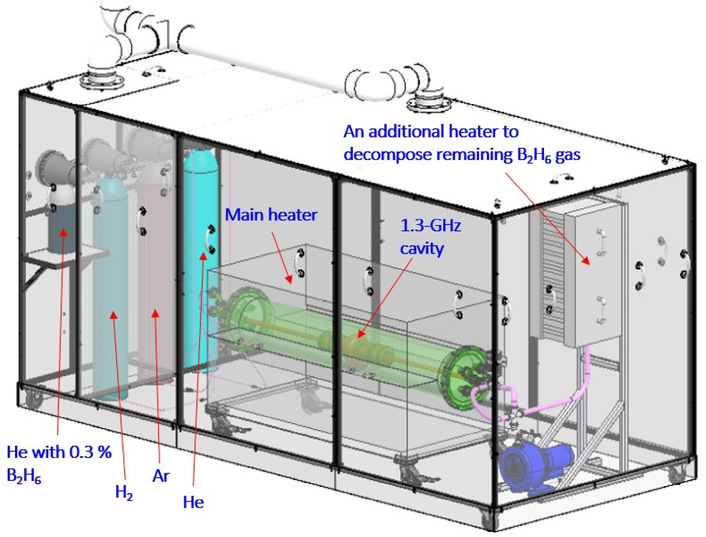

Figure: New coating system 3D model

Expected to be operational by September 2021.

Conclusions

- Slow cooling procedure tested successfully
- Funding secured for a new full-scale coating system
- First B coating expected by end of Aug 2021 – MgB_2 cavity coating will follow