

Development of Aerogels & Foams for LANL Target Assembly

Camille H. Wong; Wendi L. Akerley; Brian M. Patterson; Theresa E. Quintana; Derek S. Schmidt; Nikolaus S. Christiansen; Barak Y. Farhi; John I. Martinez; Sasi Palaniyappan; Pawel Kozlowski; Ahmed Elshafiey | Target Design & Engineering Team, Engineered Materials Group (MST-7), Materials Sciences and Technology Division, Los Alamos National Laboratory, Los Alamos, NM 87545, USA

Introduction

This study focuses on several methodology developments of aerogels and other target foams at Los Alamos National Lab which provides target assembly parts for both the Omega and National Ignition Facility. The main foams and gels used in targets include a variety of different silica aerogels, doped aerogels and Divinylbenzene (DVB) foams. The aerogel and foam formulations and processes were and are currently being investigated and developed extensively to obtain optimal conditions for density accuracy and repeatability. Using the developed methods, the gels and foams than both use a CO₂ supercritical dryer at temperatures from 10-45°C to bypass the critical point and solidify. Running the CO₂ supercritical dryer weekly allows for a focused study of the dryer's impact on product's density and physical properties. Examples of this drying method are showcased with characterization for quality assurance

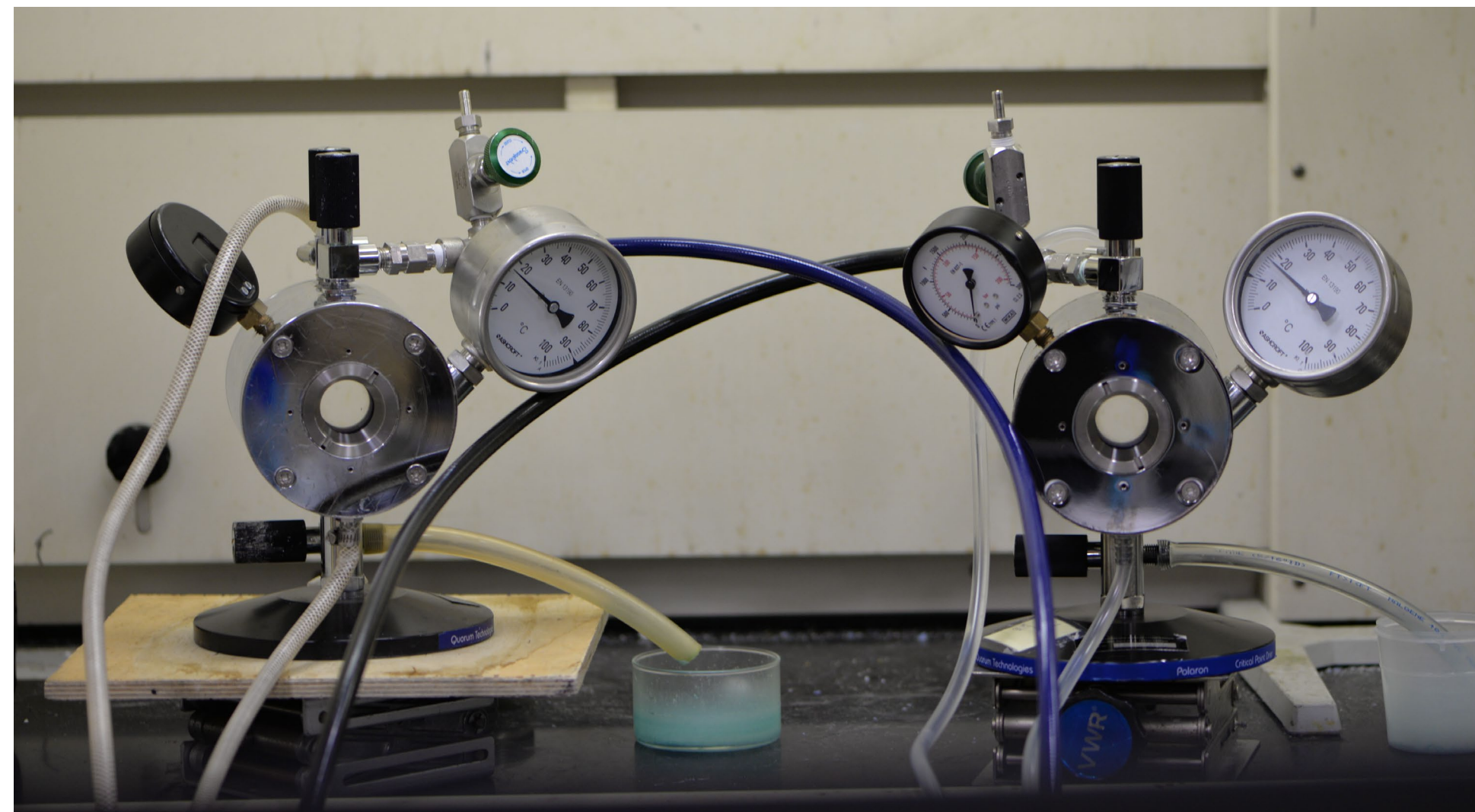


Image 1. Polaron, CO₂ supercritical dryers with low temperature and pressure capacity.

Silica Aerogels

Aerogels made with silica and other silica-based monomer result in a variety of opacity levels, ranging from transparent to opaque. Aerogel can be synthesized to fit low- and high-density profiles as well.

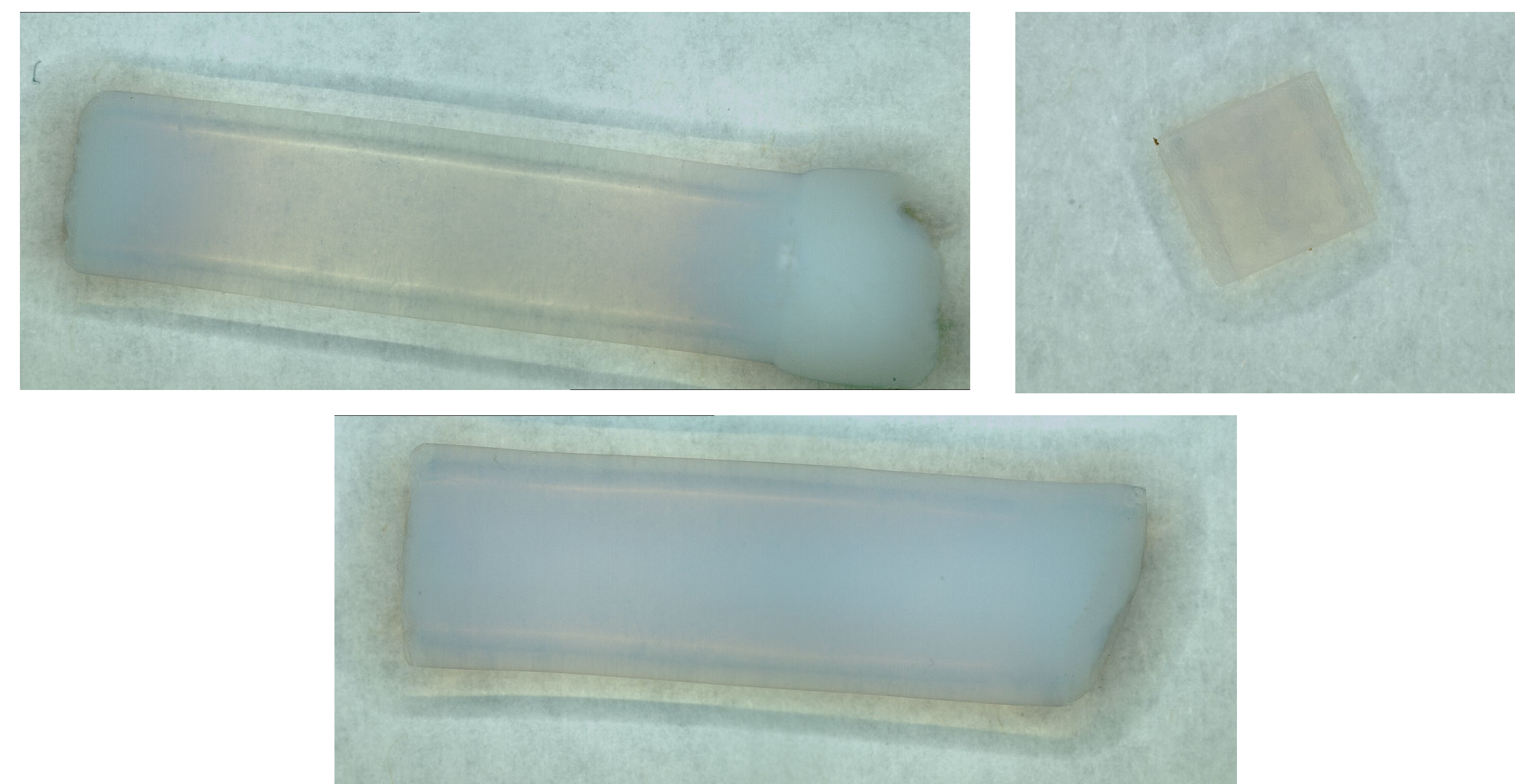


Image 2. Optical images on VR Keyence of Silica Aerogels at different levels of opacity.

Doped Aerogels

The doped aerogel that we use for our targets starts as a silica-based aerogel with either particles, compounds or other monomers added. Examples for our dopants are Scandium Chloride, 1µm Vanadium oxide and Vanadium coated micro spheres. We have also filled 3d printed lattices with Scandium Aerogel.

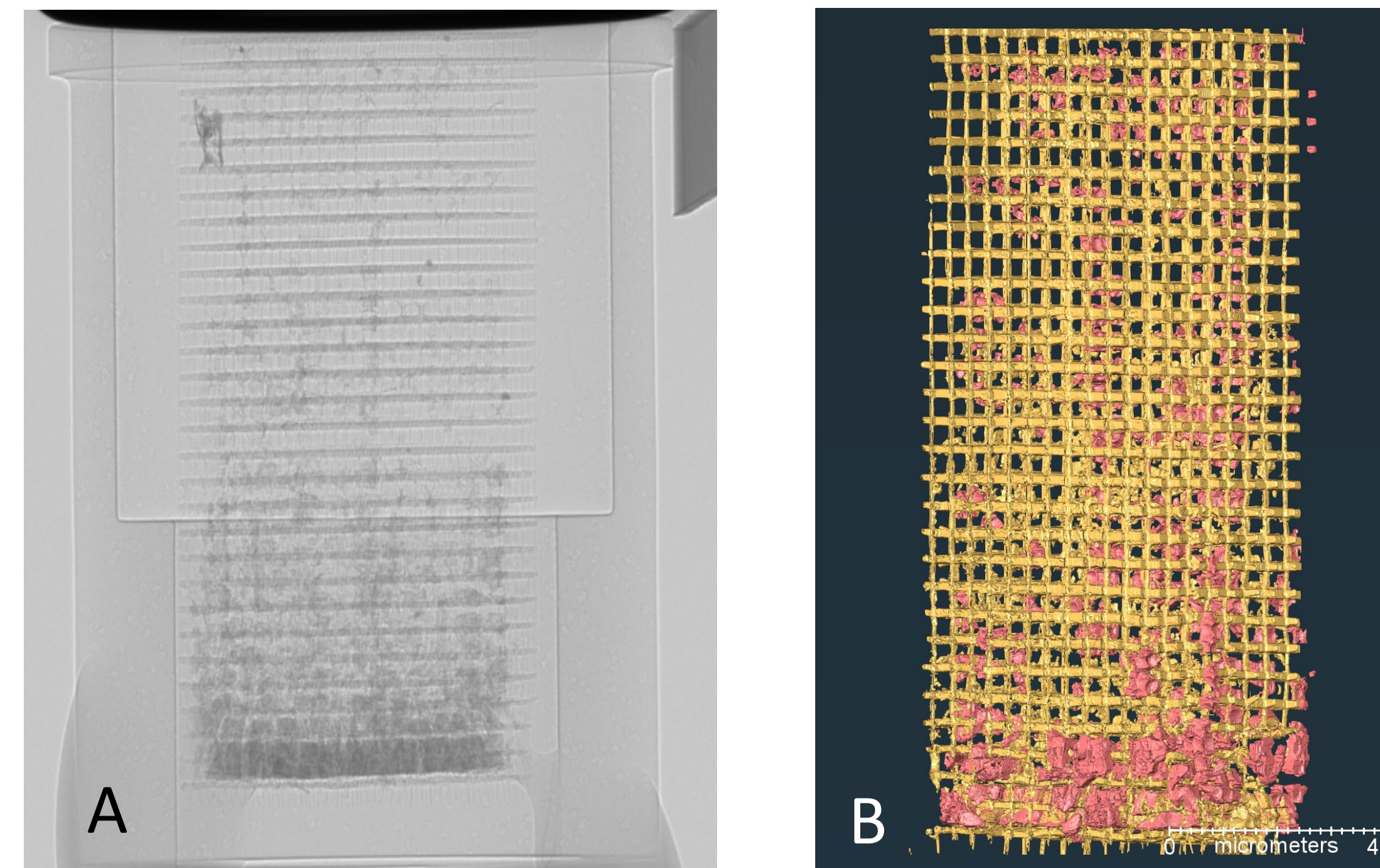


Image 3. (A) VERSA Radiograph image of target with 2PP lattice filled with Scandium Aerogel. (B) X-Ray CT rendering of target with 2PP lattice filled with Scandium Aerogel, red particles.

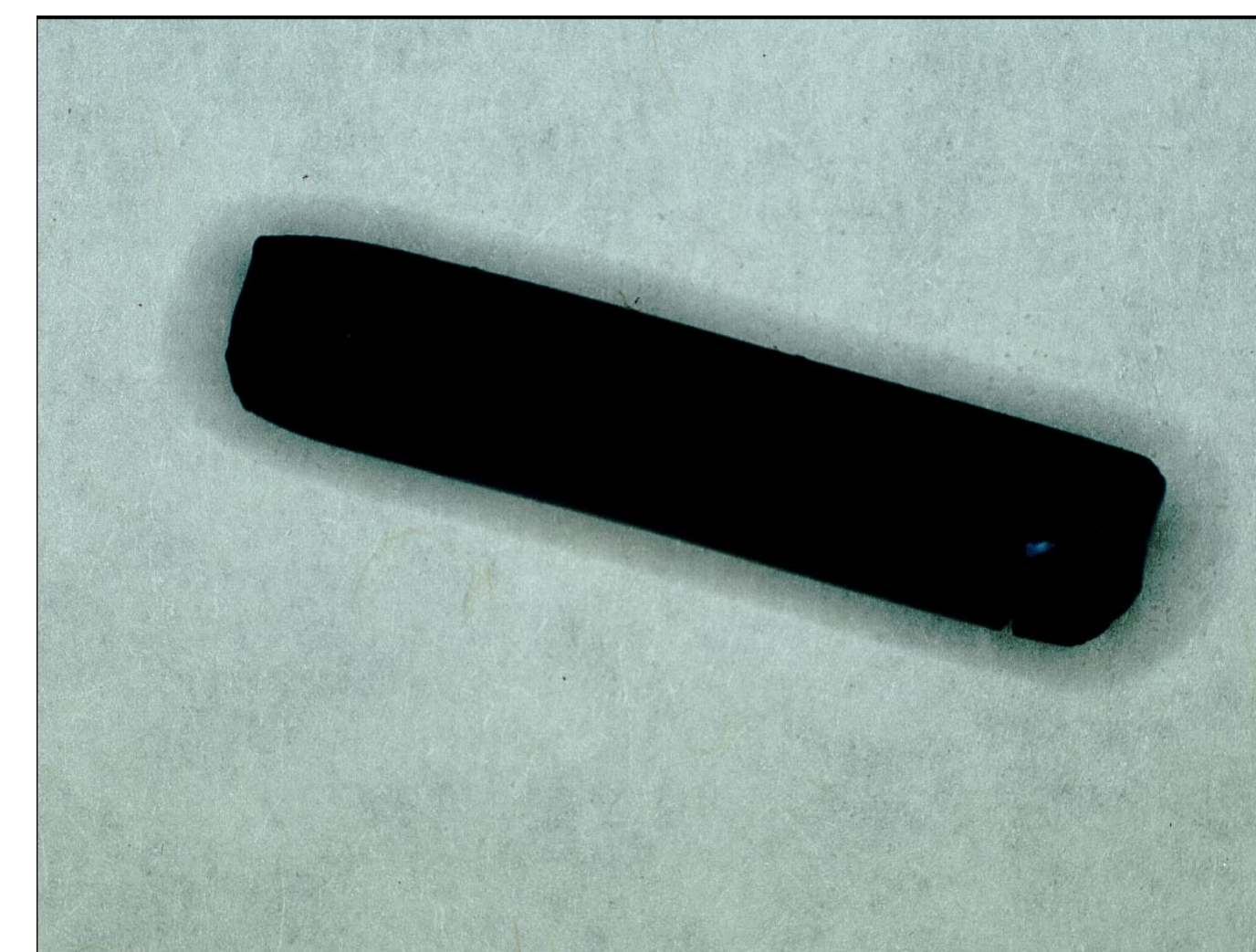


Image 4. Optical images on VR Keyence of 1 µm particle Vanadium oxide and Scandium doped Aerogel.

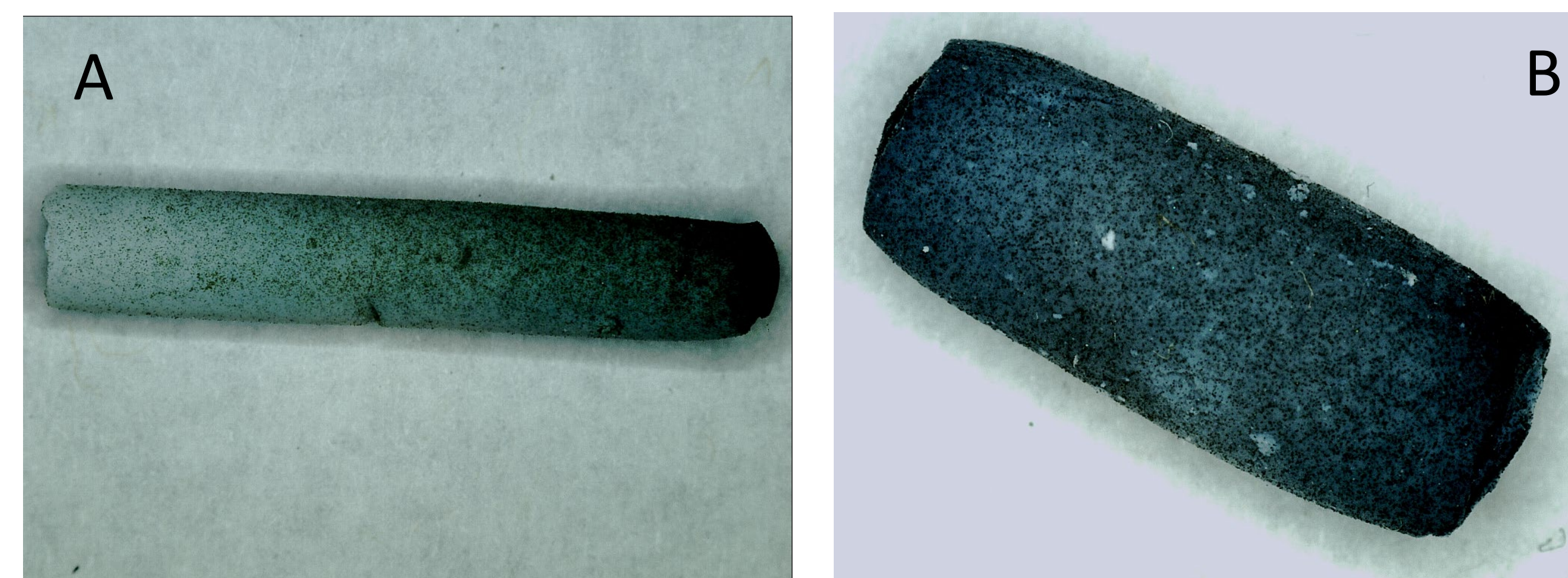


Image 5. Optical images on VR Keyence of Vanadium coated micro spheres and Scandium doped Aerogels, (A) gradually dispersed micro spheres, (B) evenly dispersed micro spheres.

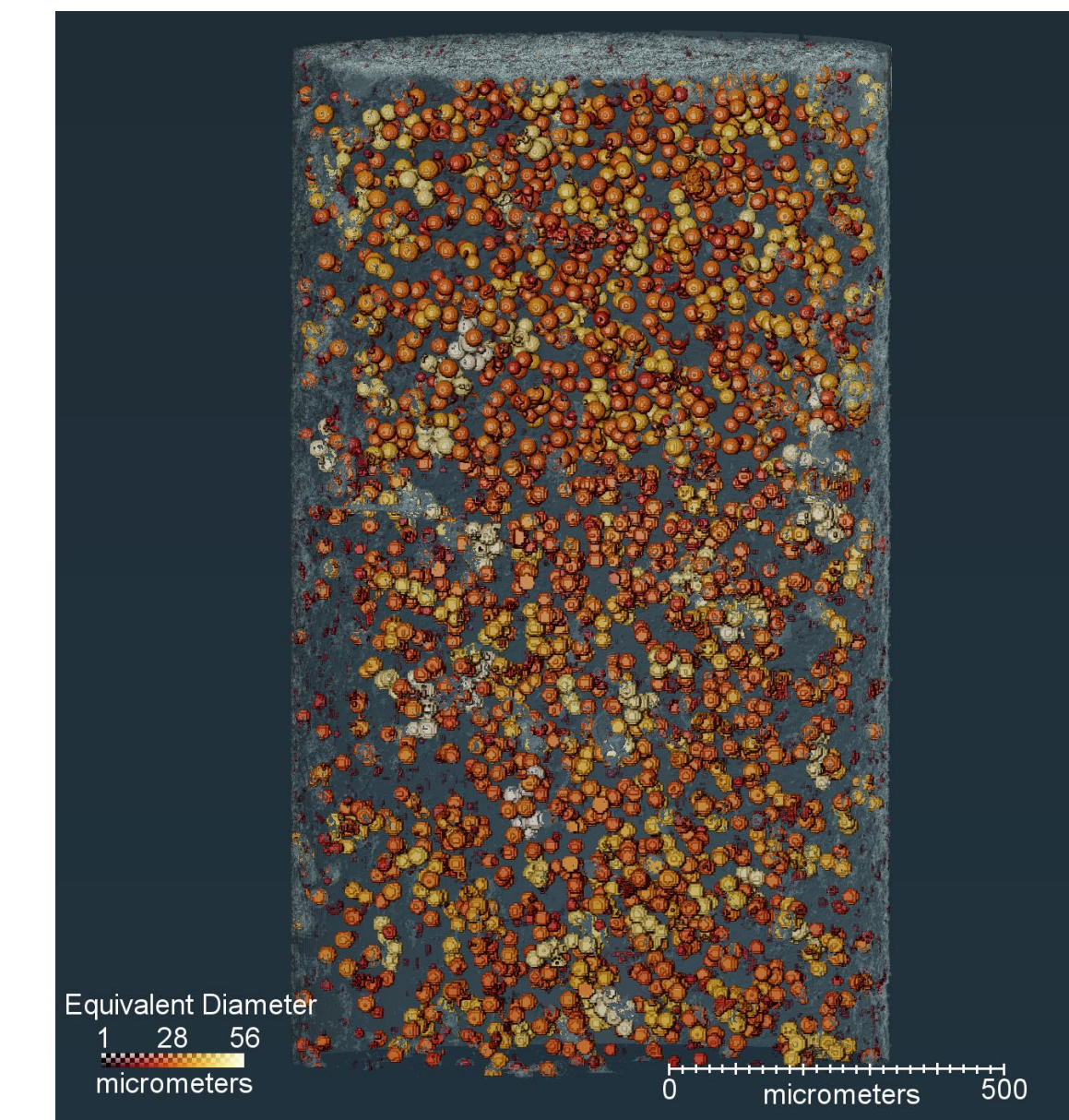


Image 6. X-Ray CT rendering of Vanadium coated micro spheres doped Aerogel.

Divinylbenzene (DVB)

DVB foams are used in both NIF and Omega targets across many campaigns. This foam is very versatile due to adaptability of the foam's density ranging from 30 mg/cc to 200mg/cc. The foam's strength allows for more precise machining techniques, hand building and robot assembly resulting in multiple applications and uses.

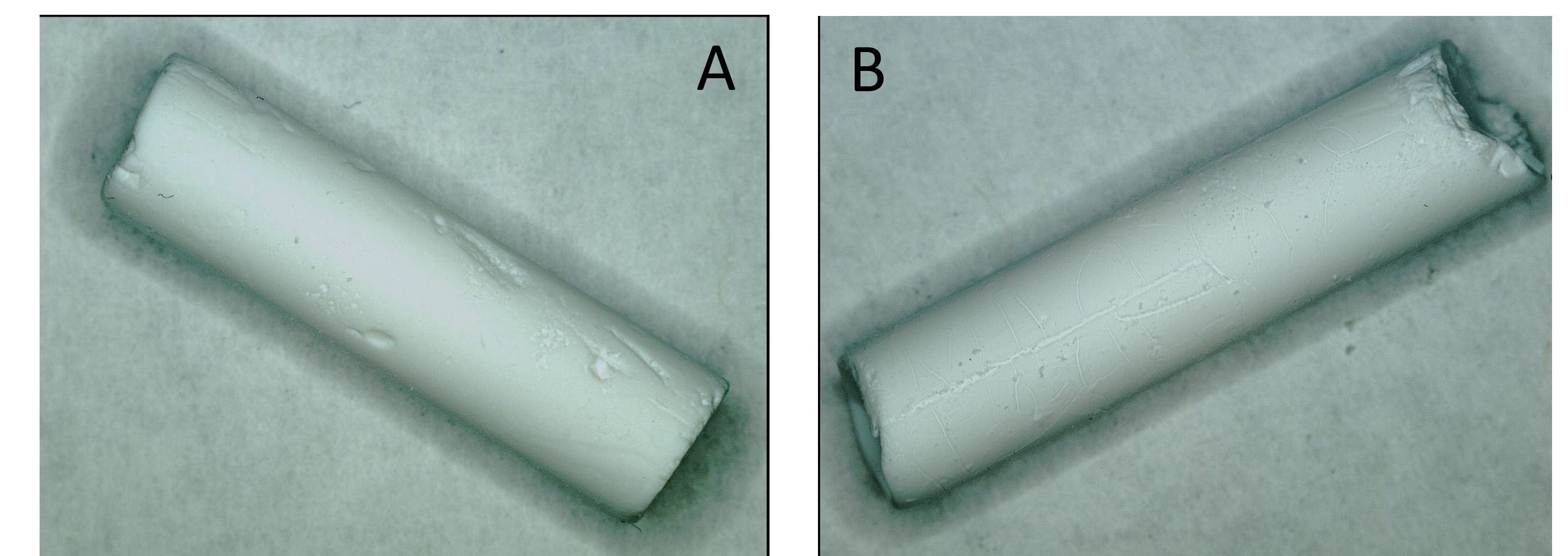


Image 7. Optical images DVB Foams on VR Keyence, (A) 100 mg/cc, (B) 35mg/cc.

Conclusion

This showcase is only a fraction of the many different Aerogels and foams being produced in Target Design & Engineering at Los Alamos National Laboratory. We are continually working to refine and replicate past work, as well as new R&D projects with Aerogels and foams. These R&D projects are critical in new target designs and development for the ICF program.

Acknowledgements

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