Contribution ID: **433** Type: **Oral Presentation**

3D Pore Roughness Extraction Technique: From 1.0 (2D) to 2.0 (3D)

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OBJECTIVE/SCOPE
Surface roughness is a sneaky troublemaker for interpreting pore size distribution from NMR T2 responses. Thus, it is of vital importance to characterize surface roughness and quantify its effect on NMR T2 relaxation. In our preceding work, the 3D pore roughness was evaluated by weighted averaging of the roughness measurements of 2D thin sections. This work presents a new-generation pore roughness extraction technique for real 3D surface roughness measurement.

METHODS, PROCEDURES, PROCESS
This work aims to develop a novel image-based roughness extraction method measuring surface roughness from a 3D benchmarking surface. The proposed workflow has four main steps, including the voxel surface diagnosis, smooth surface reconstruction, benchmarking surface generation, and 3D roughness parameterization. The first step is to examine if any vacancies or discontinuities exist on the voxel surface. A topology fix operation will be applied if necessary. Then we use the spherical harmonic method to reconstruct the smooth surface and the benchmarking surface with the volume conservation constraint. Height variations between two surfaces are evaluated, as a metric of surface roughness, and then converted to a 3D surface plot for roughness parameterization. We characterize the surface roughness using the pore roughness coefficient (PRC), defined in our previous work, and a 3D PRC value will be evaluated for each pore structure.

RESULTS, OBSERVATIONS, CONCLUSIONS
The accuracy of the proposed method is first validated with regular pore shapes (e.g. spherical, cube, tetrahedron) with smooth surfaces. As expected, the surface plots exhibit horizontal planes across 0, implying the proposed method can handle any pore shape even free of roughness. Then we measure the surface roughness of synthetic rough pores designed in our previous work, and compare 3D PRC values with the previous ones. Numerical results demonstrate another expectation that 2D image thin sections may not fully capture the roughness heterogeneity and anisotropy in the 3D space. It is worth noting that the key to the success of roughness measurement is the determination of the benchmarking surface from which the surface height variations are calculated. When creating the benchmarking surface, it is necessary to examine if the created surface excludes the fine-scale textures as much as possible and meanwhile the volume enclosed by the surface remains the same. In the end, the proposed method is applied to measure the surface roughness of real pore structures; a physically meaningful T2 correction factor is derived as a function of roughness intensity.

NOVEL/ADDITIVE INFORMATION
We improve our image-based pore roughness extraction method to measure surface roughness directly from 3D benchmarking surfaces. The proposed method is robust, regardless of pore shape, surface roughness heterogeneity, and anisotropy. Thus, this work offers an accurate and effective approach to characterizing the surface roughness of pixelated porous structures.

Participation

In-Person

References

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