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A Comparison of the Appearance of Various High Resolution Sputter Coatings.

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When the need to coat samples for high resolution scanning electron microscopy arises, the microscopist is faced with a considerable number of options. If only one sputter coater is available there still is the choice of which coating material, coating thickness, coating amperage and in some cases, chamber height to use. Two concerns investigated by Erlandsen et al. [1] are, (1) will the coating effectively reduce the potential for specimen "charging" artifacts and (2) will the coating obscure features that are of interest? They found that when backscatter electron imaging (BEI) small colloidal gold particles, the improvement in image quality by reducing charging was inversely proportional to the coating thickness when using platinum. When imaging human lymphocytes a 1 nm coating of Pt greatly reduced charging for BEI but was much less effective when imaging using secondary electrons (SE). They also found that when using BEI, a ~2 nm coating of Pt did not obscure 6 nm gold particles but that ~5 nm did and that ~10 nm of Pt coating made it difficult to discriminate between 12 nm and 18 nm gold particles.

If there is little danger of the coating obscuring features of interest there remains the question of coating appearance. Will the coating be visible and if so how obtrusive will it appear? The purpose of this work is to provide some examples of coatings made using a selection of the commonly available coating options with the hope these examples will aid in the choice of coating options. All coatings were made with a Cressington 208HR sputter coater fitted with a MTM-20 thickness controller and using high purity (grade 4.8) argon. The primary samples were polished 12 mm diameter steel disks (AFM sample mounts). Polishing was done using methodology suitable for electron backscattered diffraction (mechanical polishing with a final step using colloidal silica on a vibratory polisher) resulting in a very smooth surface (Fig. 1). This allowed comparisons with little possibility of surface morphology contributing to coating appearance. The coatings were imaged using a Zeiss 1530VP FE-SEM operating at 1.0 KeV and 10.0 KeV, 2-4 mm working distances at magnifications of 25,000 to 100,000x. The coating options compared were thickness (1.0 nm, 2.0 nm and 3.0 nm), chamber height (65 mm and 150 mm), sputter current (40 mA and 80 mA) and material (Pt/Pd, Pt and Cr).

The results suggest some potentially useful compromises, Figures 2-4 show the expected grain size increase with increased coating thickness of Pt/Pd from 1 nm-3 nm (1.0 KeV, 100,000x). The difference in apparent size between 1.0 nm and 2.0 nm coatings is fairly subtle and suggests that doubling the thickness from 1 nm to 2 nm to reduce potential charging artifacts may not greatly impact appearance. Figures 5-6 illustrate this as applied to imaging diatom frustules with 2.0 nm and 3.0 nm Pt/Pd coatings respectively (10 KeV, 100,000x) [2].

References
[1] S.L. Erlandsen et al., Scanning Microsc. 13 (1999) 43.
[2] James C. Long of Ted Pella, Inc. generously loaned several targets and offered valuable suggestions for the operation of the 208HR coater. The 1530VP FE-SEM acquisition was supported by the National Science Foundation under Grant No. DBI-0116835.

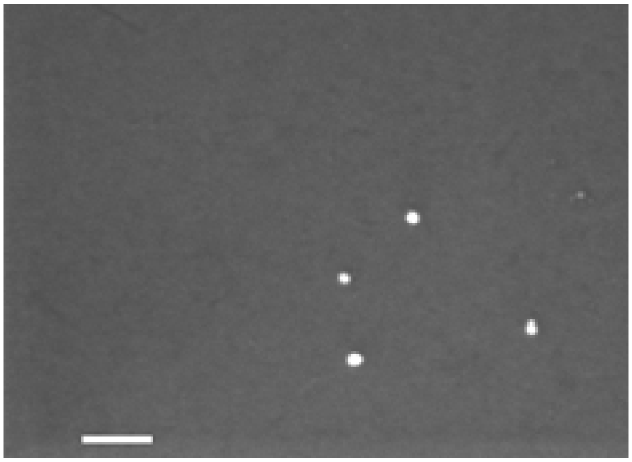

Fig.1. SE image of a polished steel disk with no coating. Bar = 100 nm.

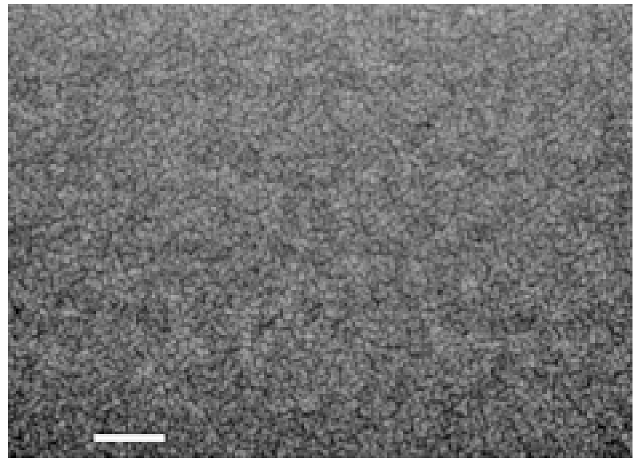

Fig. 2. SE image of a polished steel disk with 1 nm PtPd coating. Bar = 100 nm.

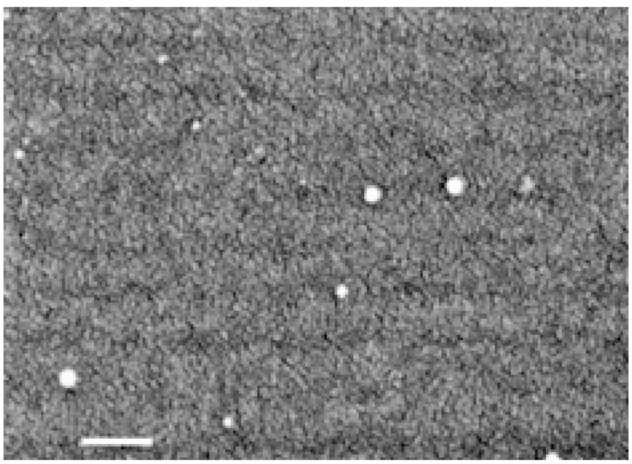

Fig. 3. SE image of a polished steel disk with 2 nm PtPd coating. Bar = 100 nm.

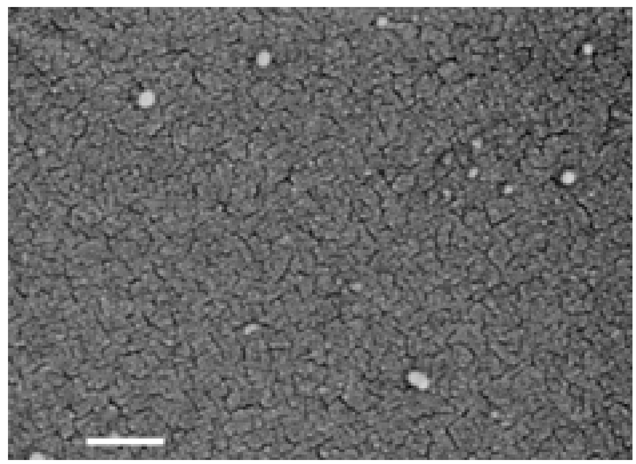

Fig. 4. SE image of a polished steel disk with 3 nm PtPd coating. Bar = 100 nm.

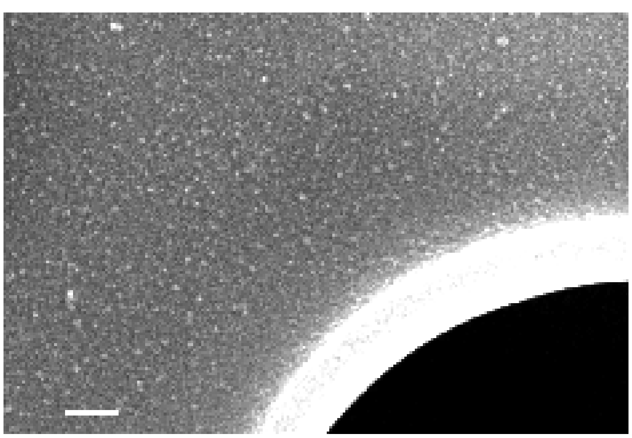

Fig. 5. SE image of a diatom frustule with 2 nm PtPd coating. Bar = 100 nm.

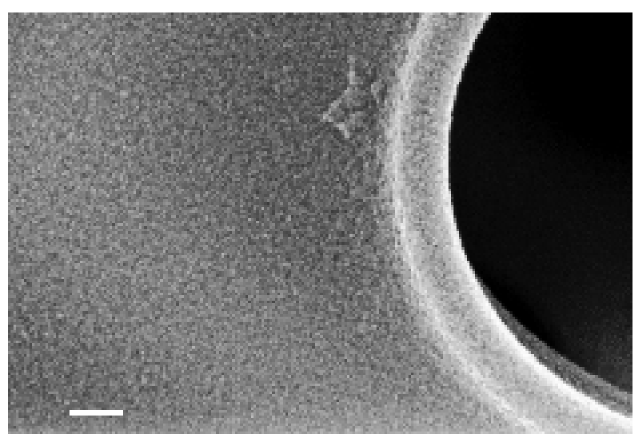

Fig. 6. SE image of a diatom frustule with 3 nm PtPd coating. Bar = 100 nm.

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