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Evaluation of thermally sprayed coatings

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Evaluation of thermally sprayed coatings

In the following results obtained by evaluation of the thermally sprayed coating samples sent by Praxair Surface Technologies and UniqueCoat Technologies.
The coatings obtained from UniqueCoat Technologies were:

SB3072-1=1350VF -38+10 um
SB3072-2=1350VF -38+10 um
SB3073=1350VF -38+10 um

The coatings obtained from Praxair were:

Prax1=1350VM 090909J021
Prax2=1350VM 090909J01
Prax3=1275H 090911J01
Prax4=1275H 090911J01-2

The coatings were evaluated using optical microscopy (Leica), microhardness tests (Matsuzawa MMT-X7+Buehler Omnimet MHT), SEM microscopy (Philips XL-30), tensile bond strength measurement and abrasion wear test (rubber-wheel abrasion test).

1. Results of UniqueCoat Technologies coatings

1.1 Optical micrographs

SB3072-1:

SB3072-1:

SB3072-2:

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SB3072-2:

SB3073:

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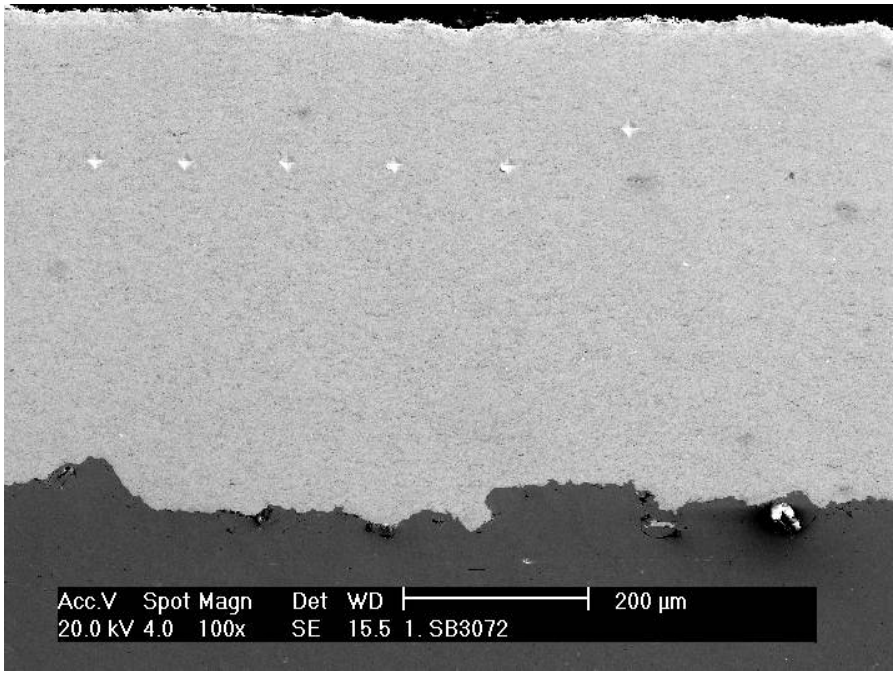
SB3073:

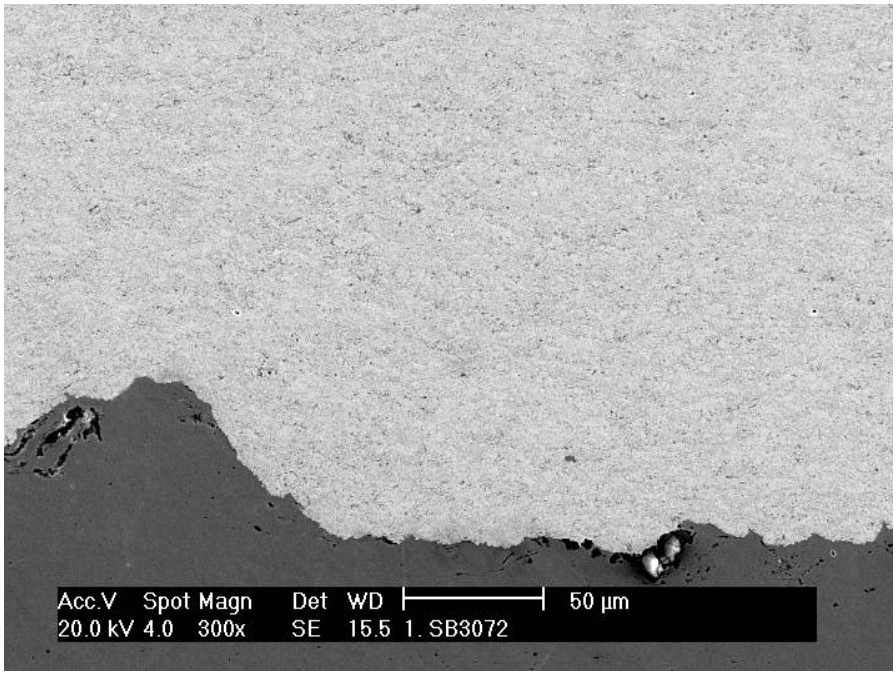
Summary of the optical micrographs: The microstructures of the SB-3072-1, SB-3072-2 and SB-3073 coatings are homogeneous and dense with very low porosity (less than 0.5%).

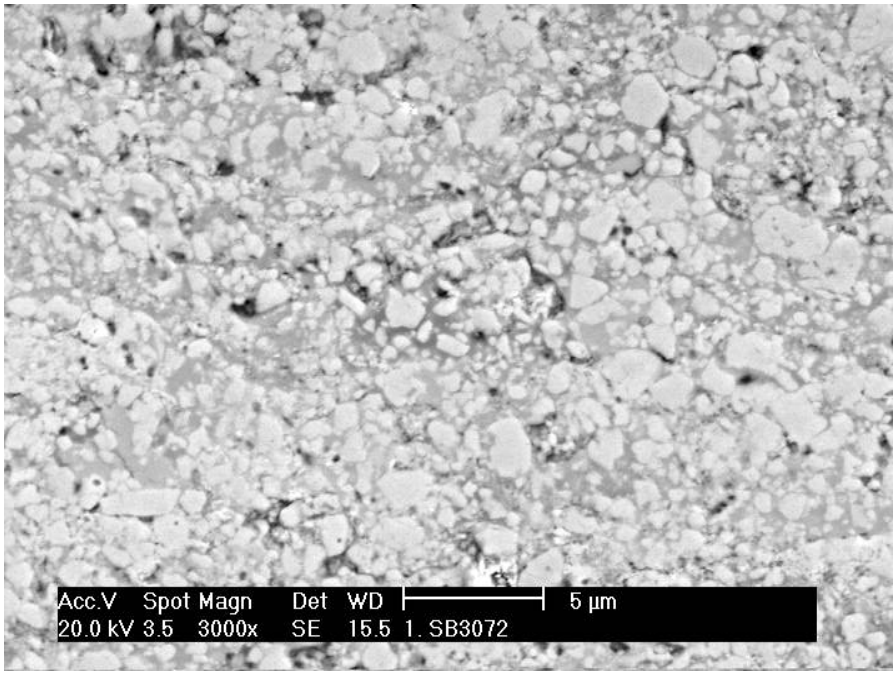
1.2 **Microhardness values ($HV_{0.3}$)** (10 measurements)

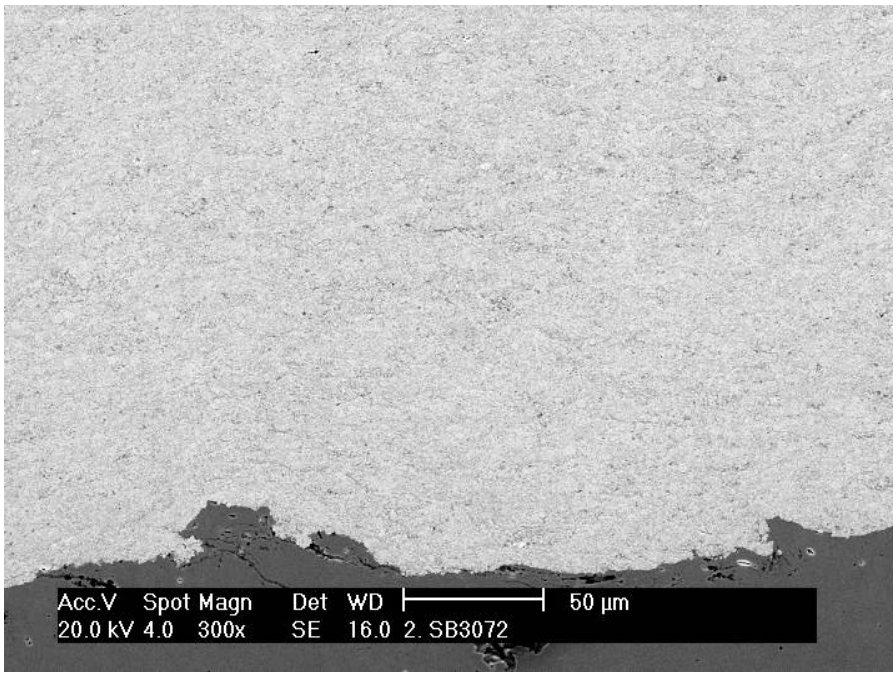
Coating:	**SB3072-1**	**SB3072-2**	**SB3073**
Max Hardness:	1440 HV	1449 HV	1449 HV
Min Hardness:	1265 HV	1209 HV	1203 HV
Mean Hardness:	1348 HV	1354 HV	1354 HV
Stddev Hardness:	65 HV	75 HV	76 HV

1.3 SEM micrographs









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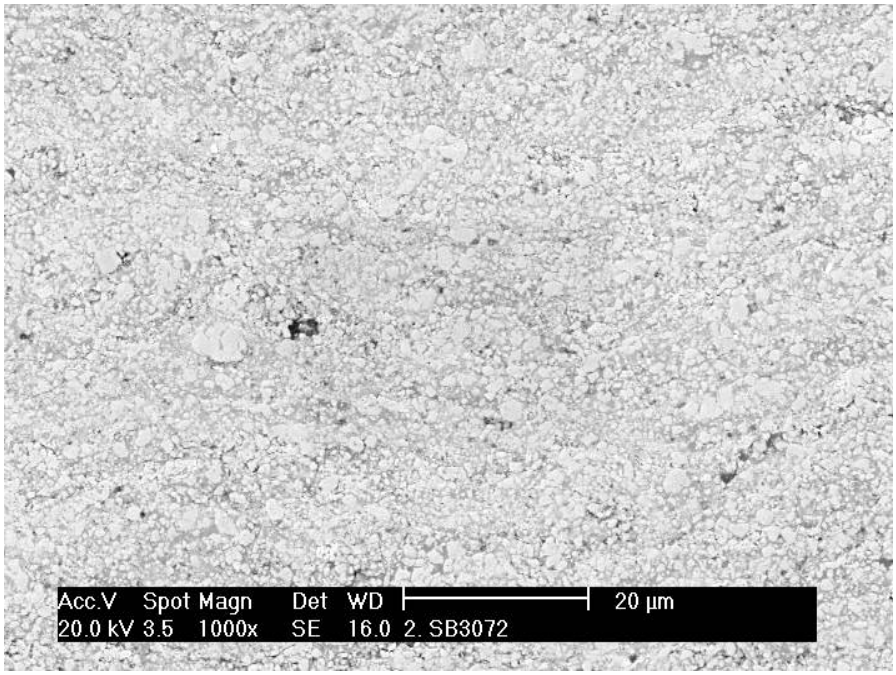

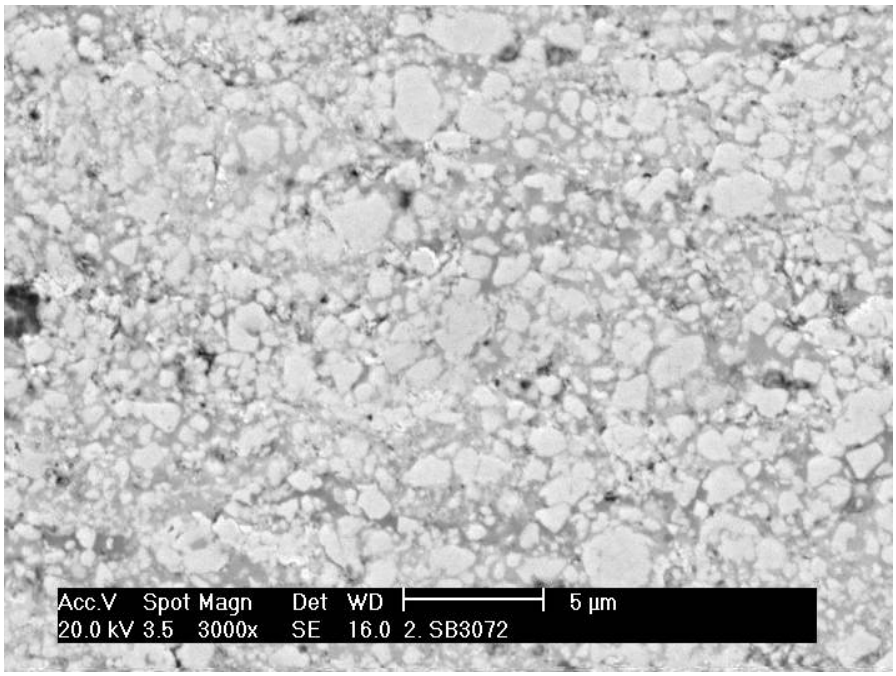

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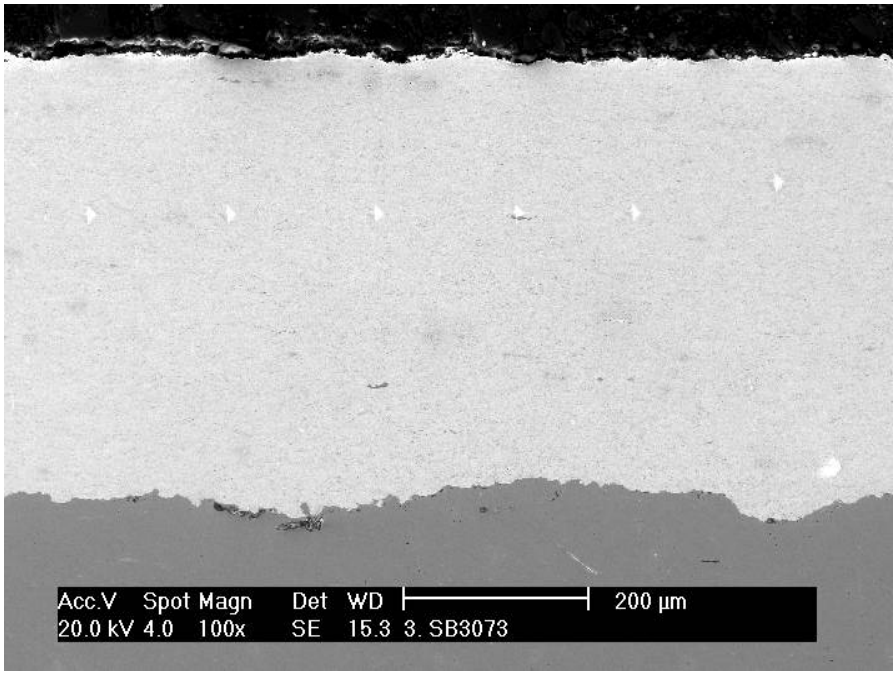

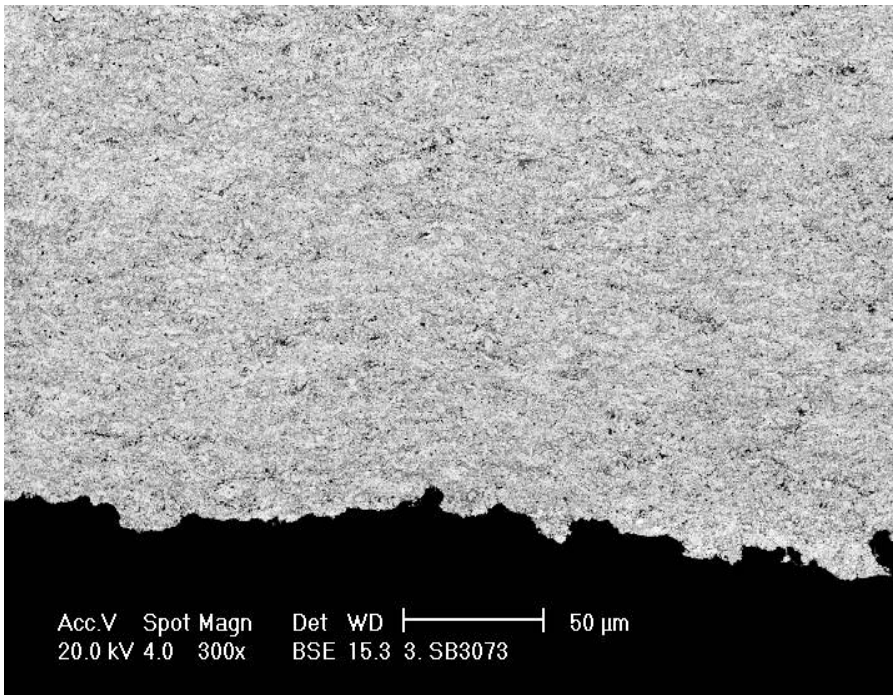

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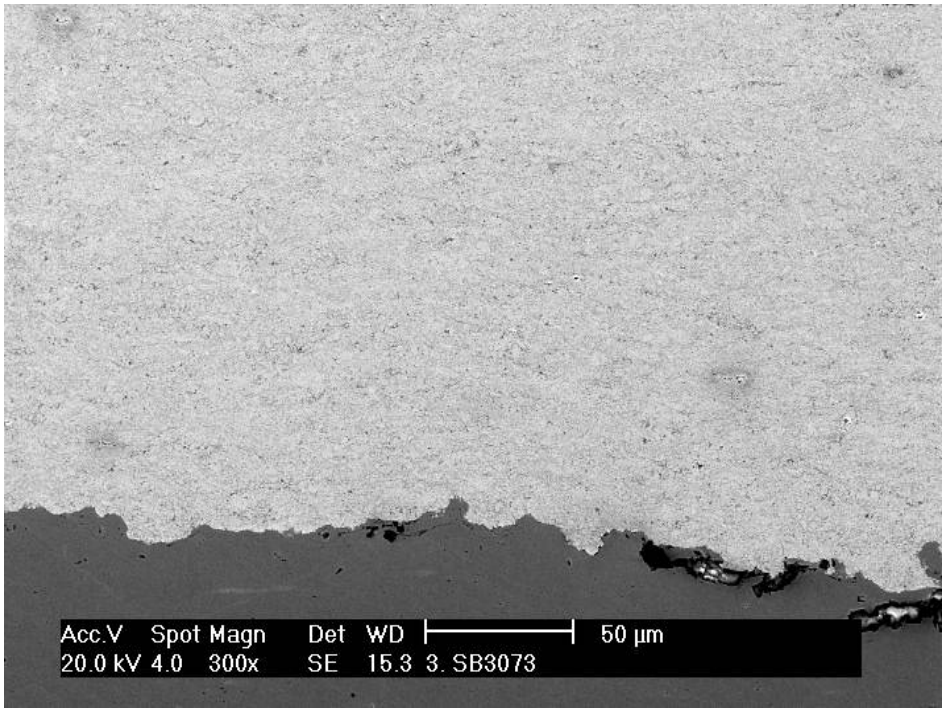

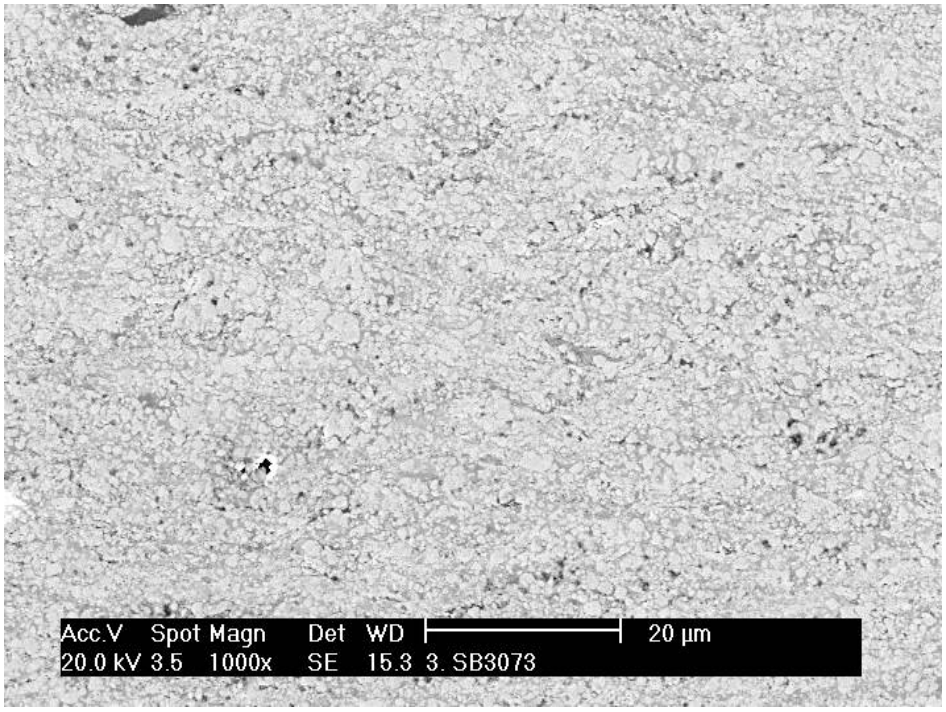

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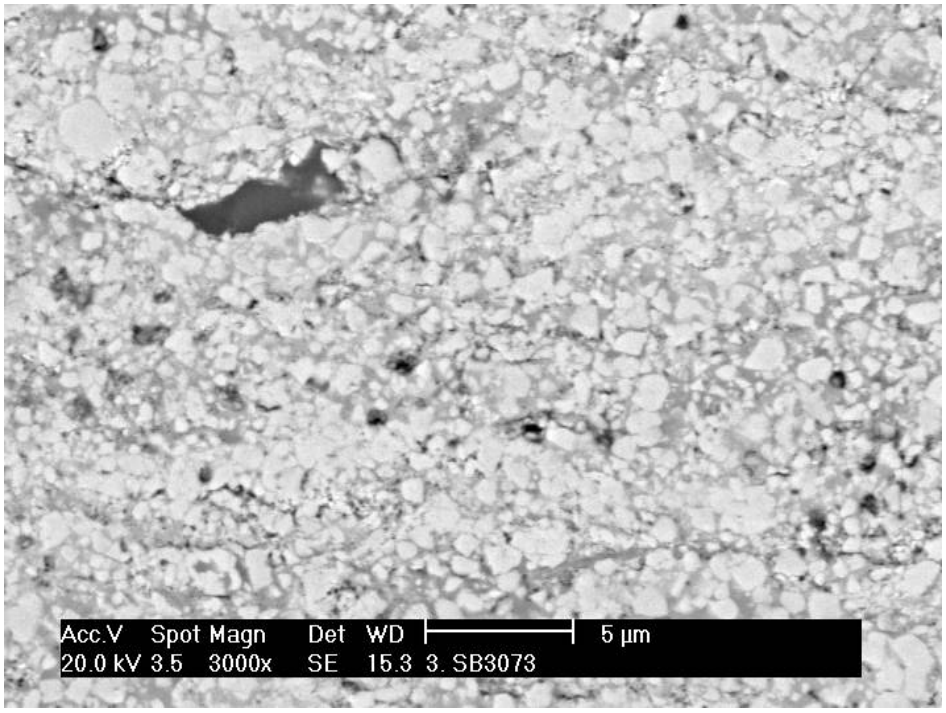


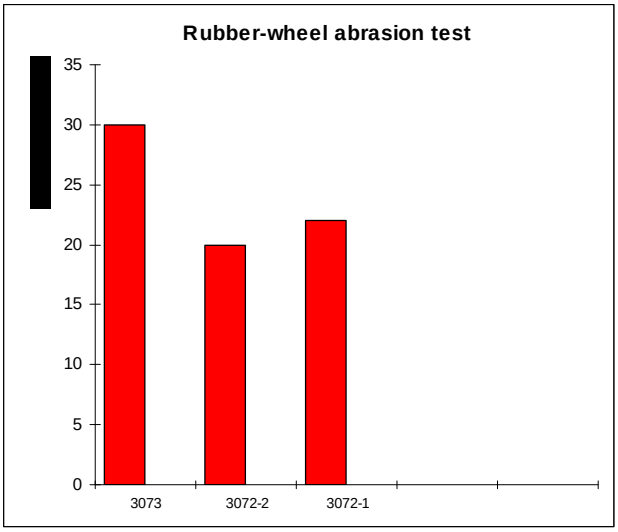
Summary of SEM micrographs: The SB-3072-1, SB-3072-2 and SB-3073 coatings showed homogeneous carbide distribution and augmented the dense structure with very low porosity (less than 0.5%) as seen also in optical micrographs.

1.4 Tensile bond strength

Tensile bond strength of the coatings was higher than 75 MPa, which was the bond strength of the glue used for testing adhesion.

1.5 Rubber-wheel abrasion test

Rubber-wheel abrasion test results are shown in the following chart. (Modified ASTM G65 test procedure, test duration one hour corresponding to a wear length of 5904 meters.). Wear resistance of the coatings is very high. Super-D-Gun SDG 2047 coating (WC-13%Co-4%Cr) tested years ago showed a weight loss of 57 mg in the same wear test.



2 Results of Praxair coatings

2.1 Optical micrographs

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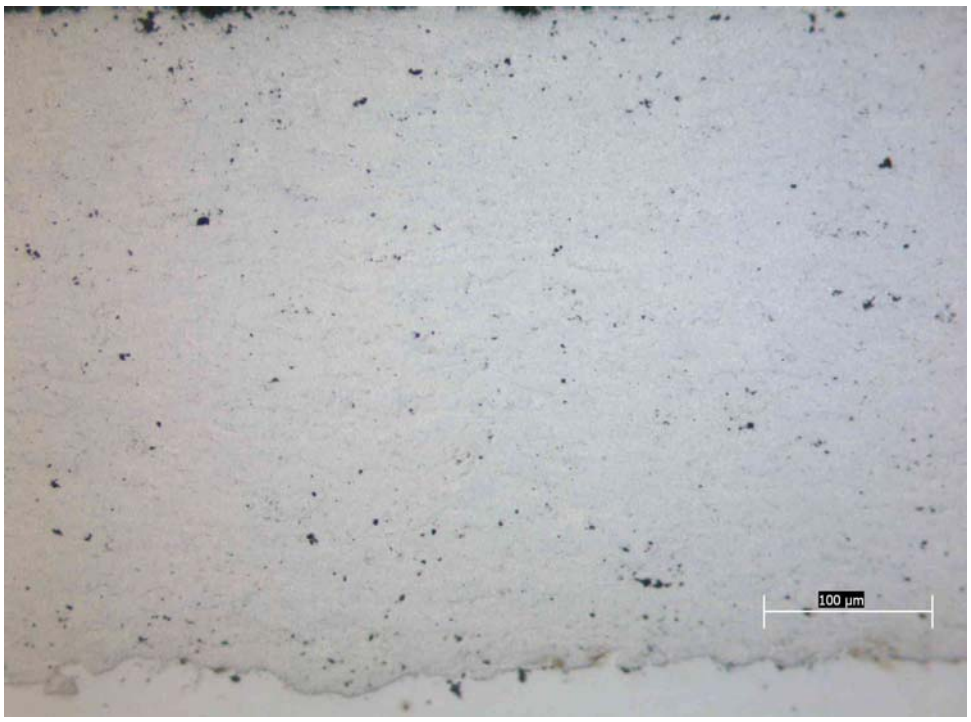

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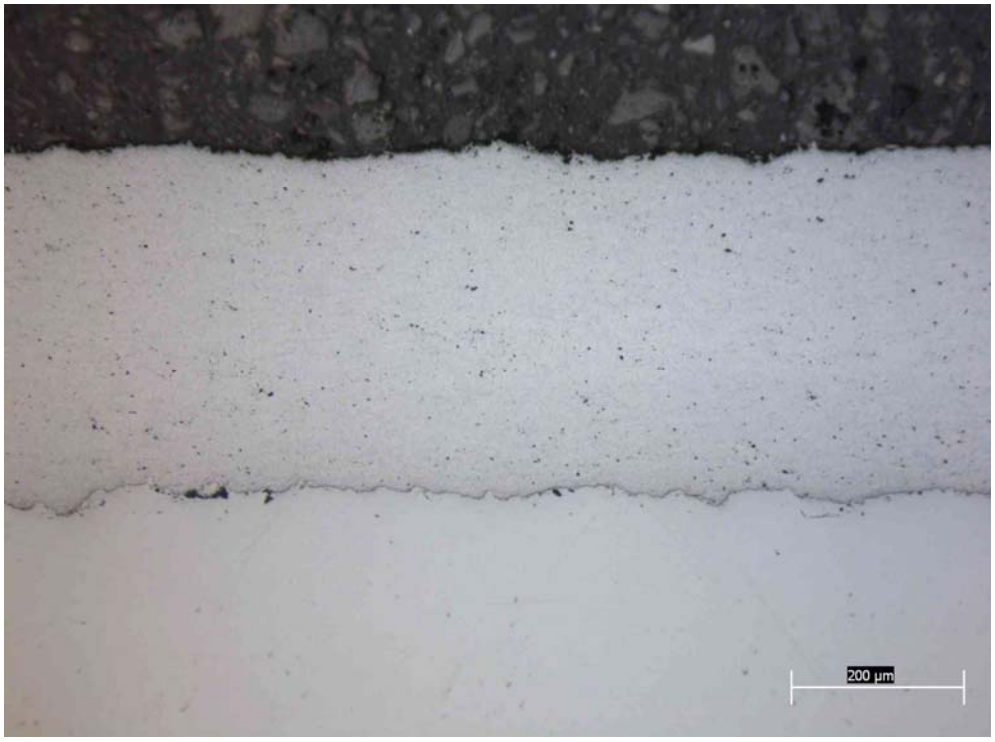
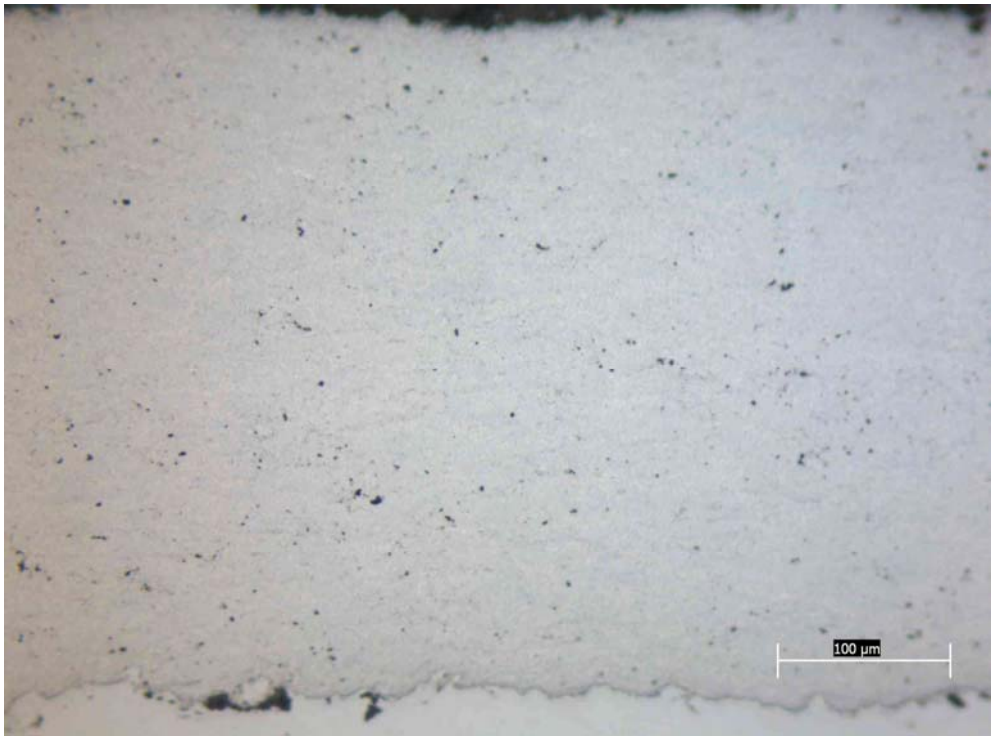
Prax2:





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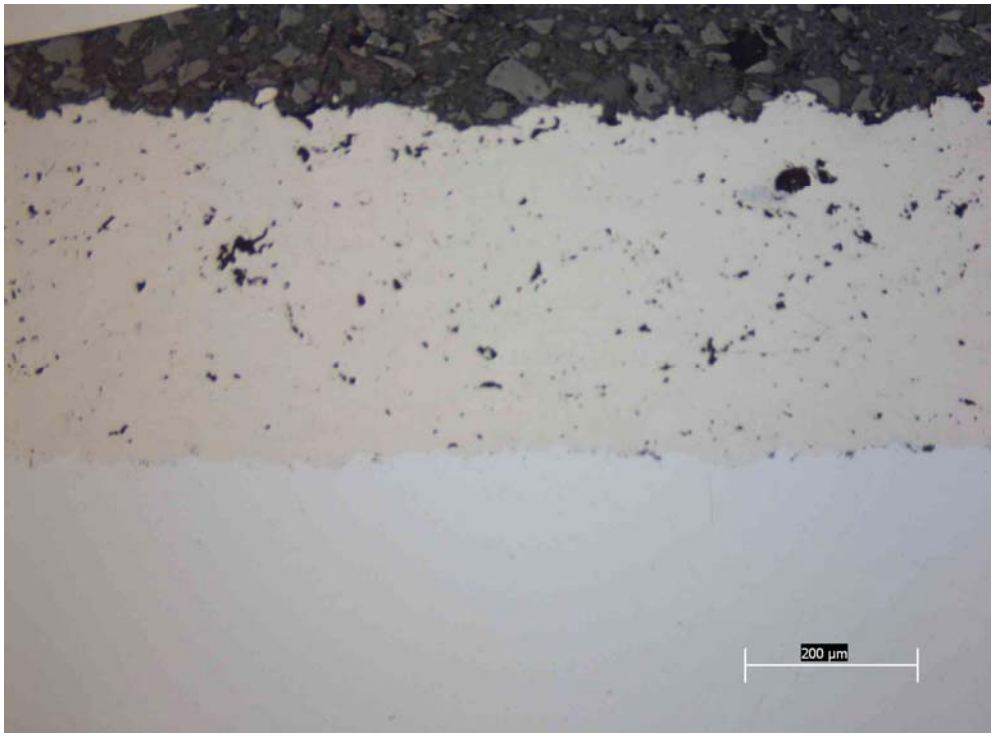
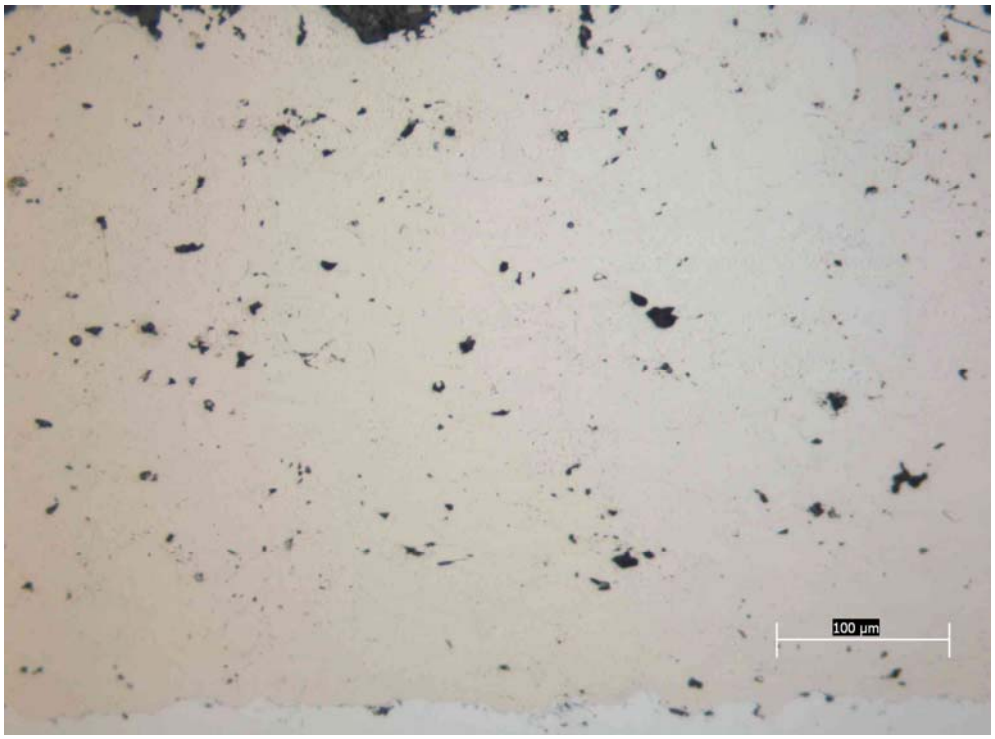
Prax3:





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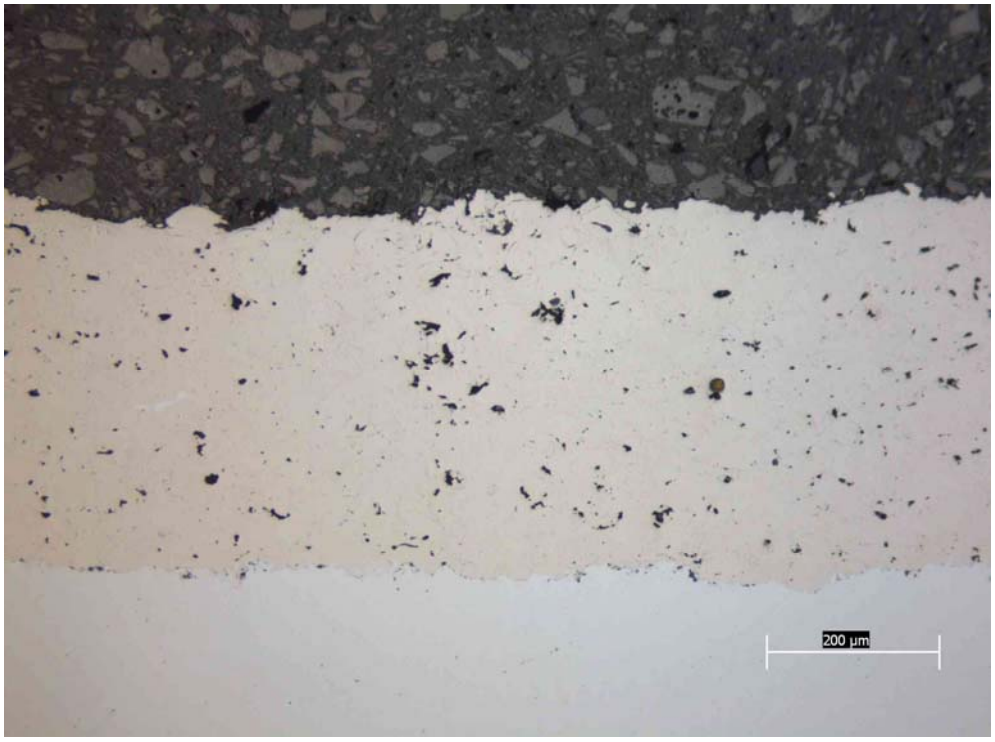
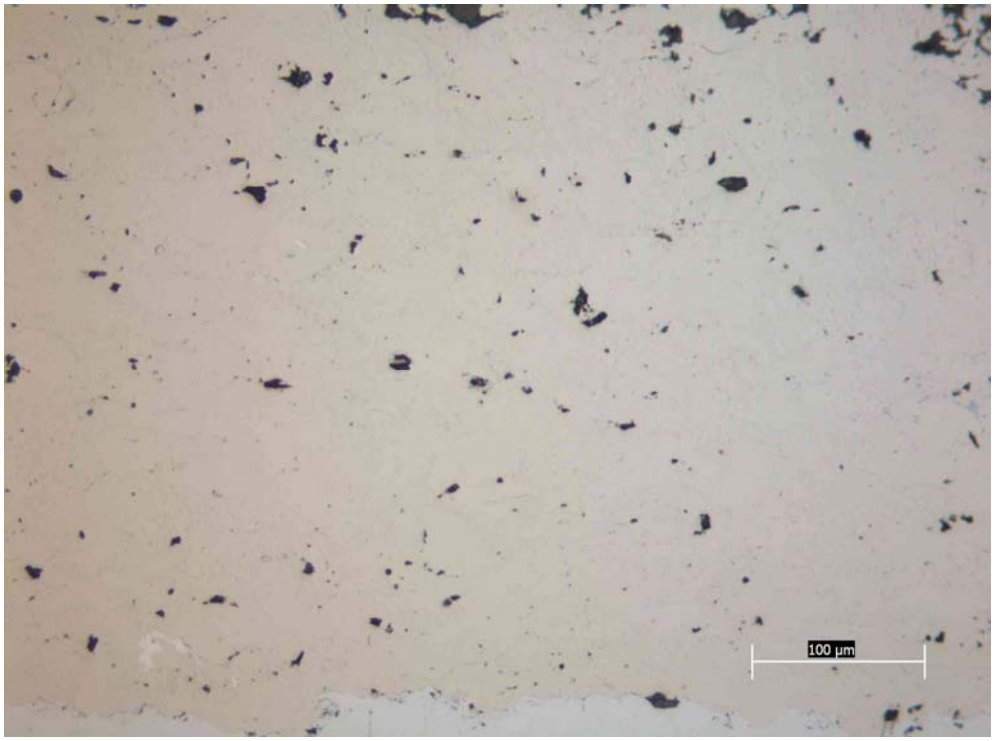
Prax4:





Summary of the optical micrographs:

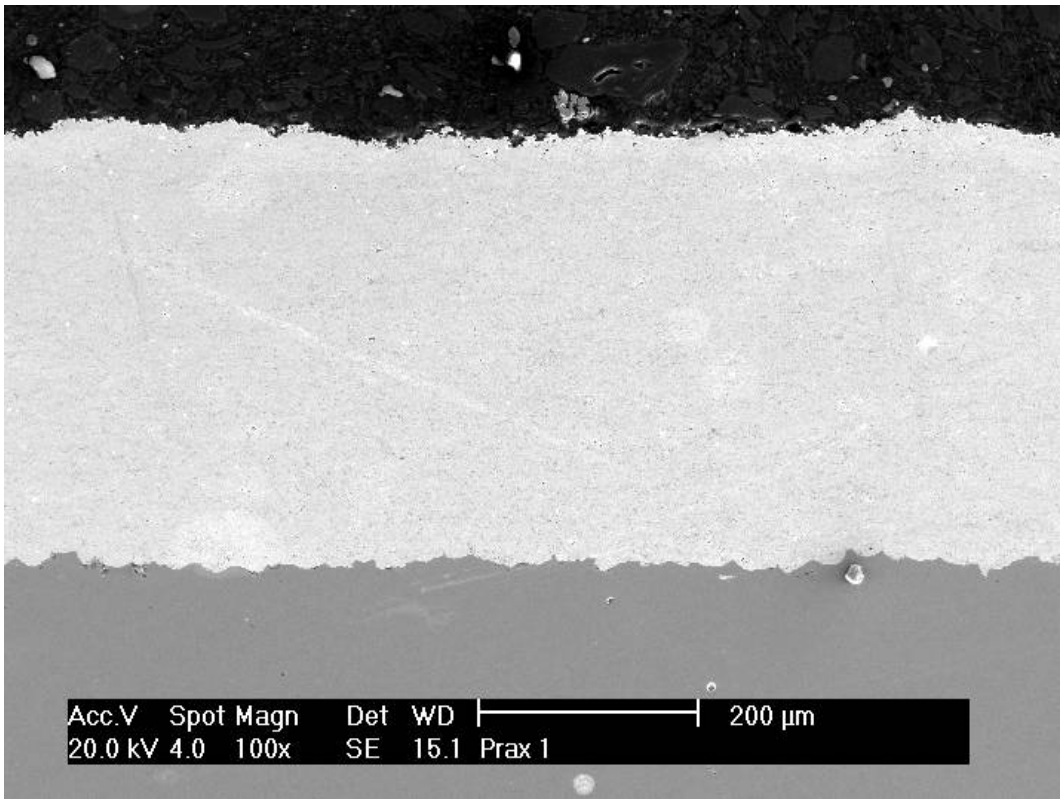
The microstructures of the Prax1 and Prax2 coatings are homogeneous and rather dense with a low porosity (less than 1 %).

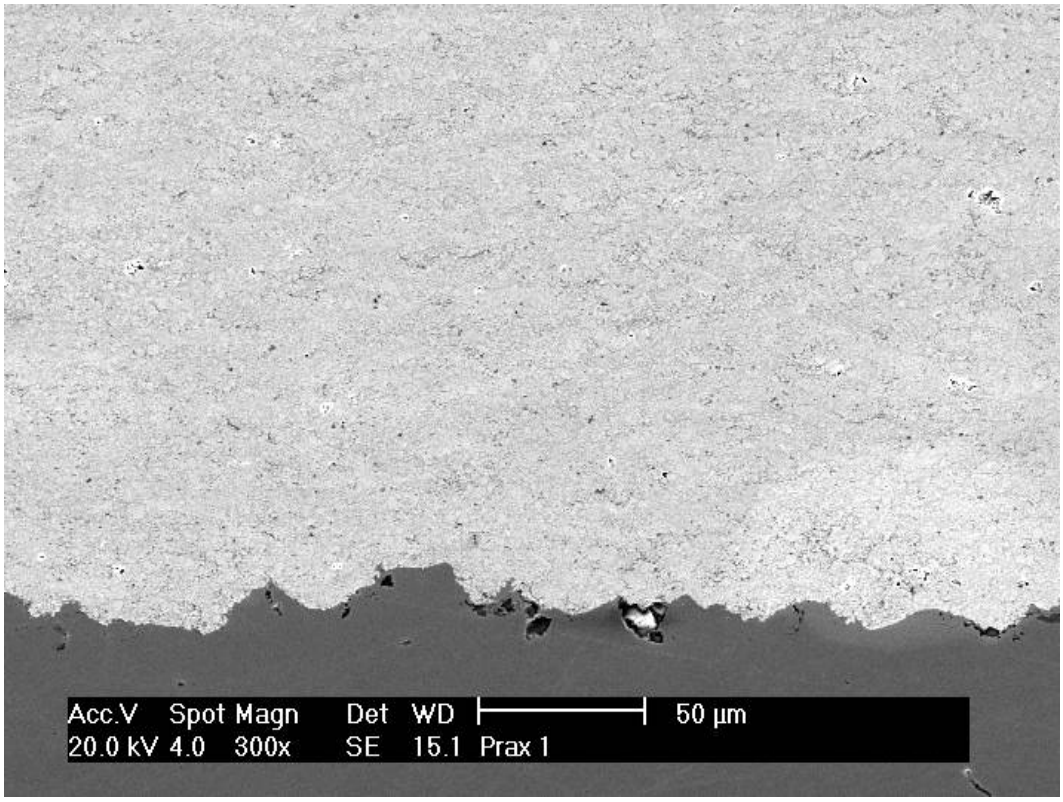
The microstructures of the Prax3 and Prax4 (NiCrBSi) coatings have a porosity of the order of 5%.

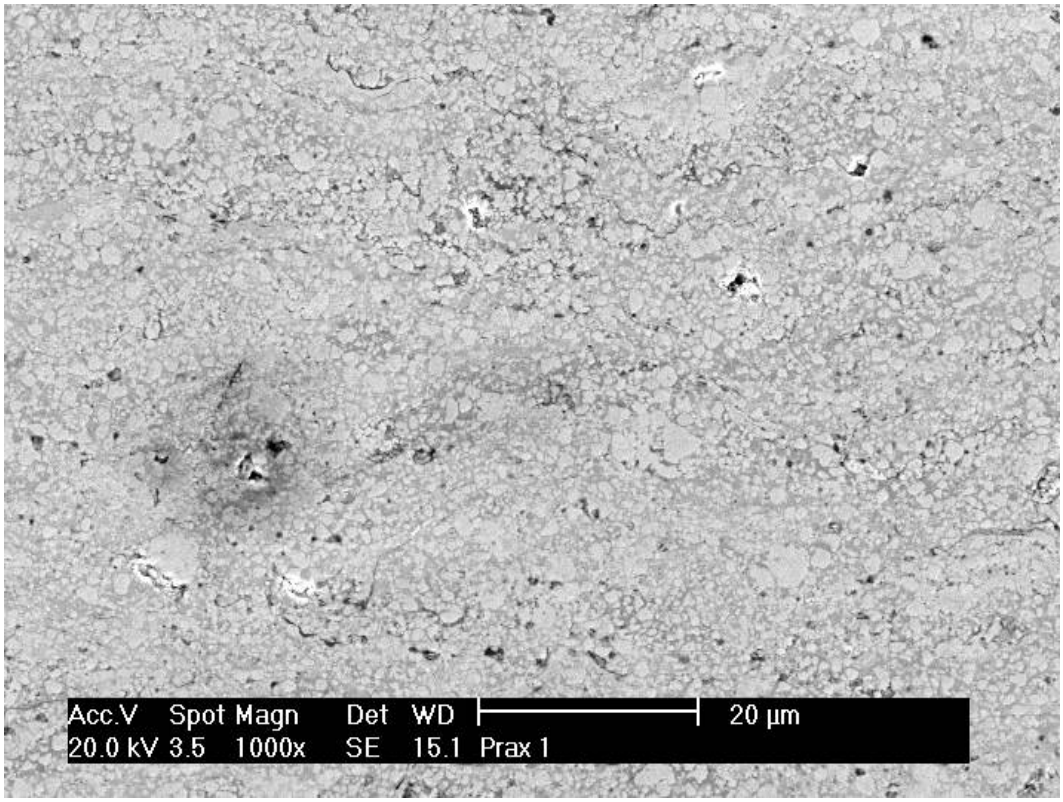
2.2 **Microhardness values (HV $_{0.3}$)** (10 measurements)

Coating:	**Prax1**	**Prax2**	**Prax3**	**Prax4**
Max Hardness:	1551 HV	1532 HV	831 HV	884 HV
Min Hardness:	1196 HV	1230 HV	616 HV	727 HV
Mean Hardness:	1371 HV	1395 HV	769 HV	803 HV
Stddev Hardness:	111 HV	78 HV	58 HV	57 HV

2.3 SEM micrographs







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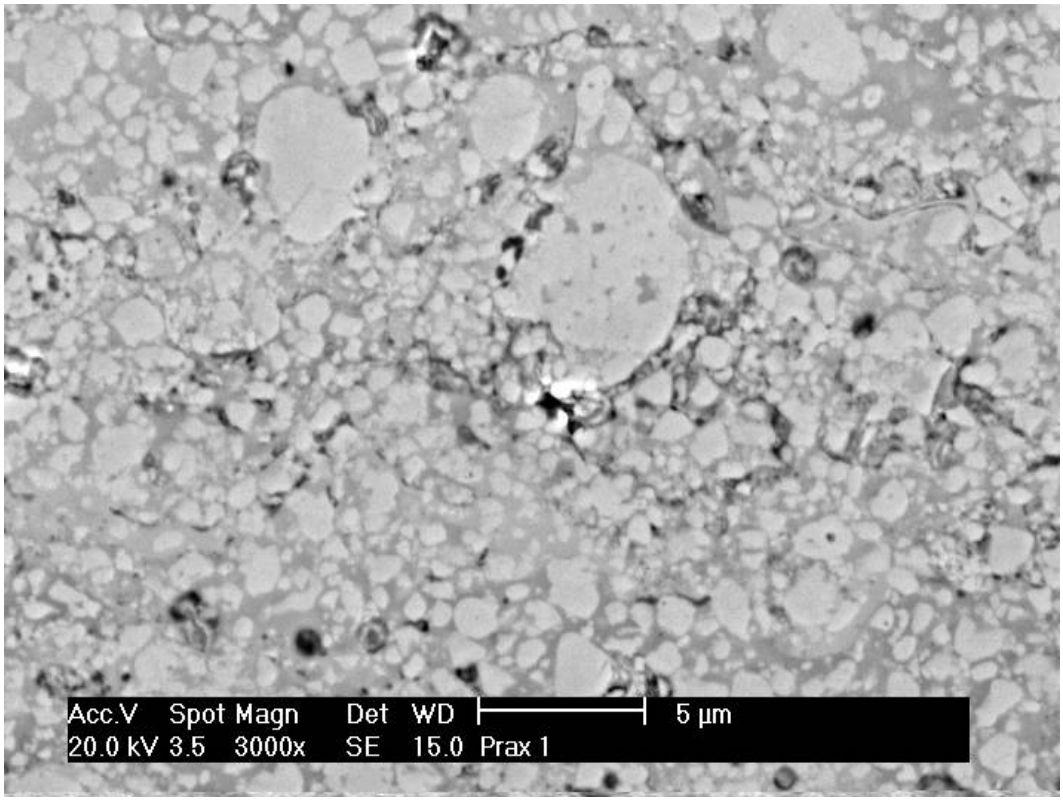

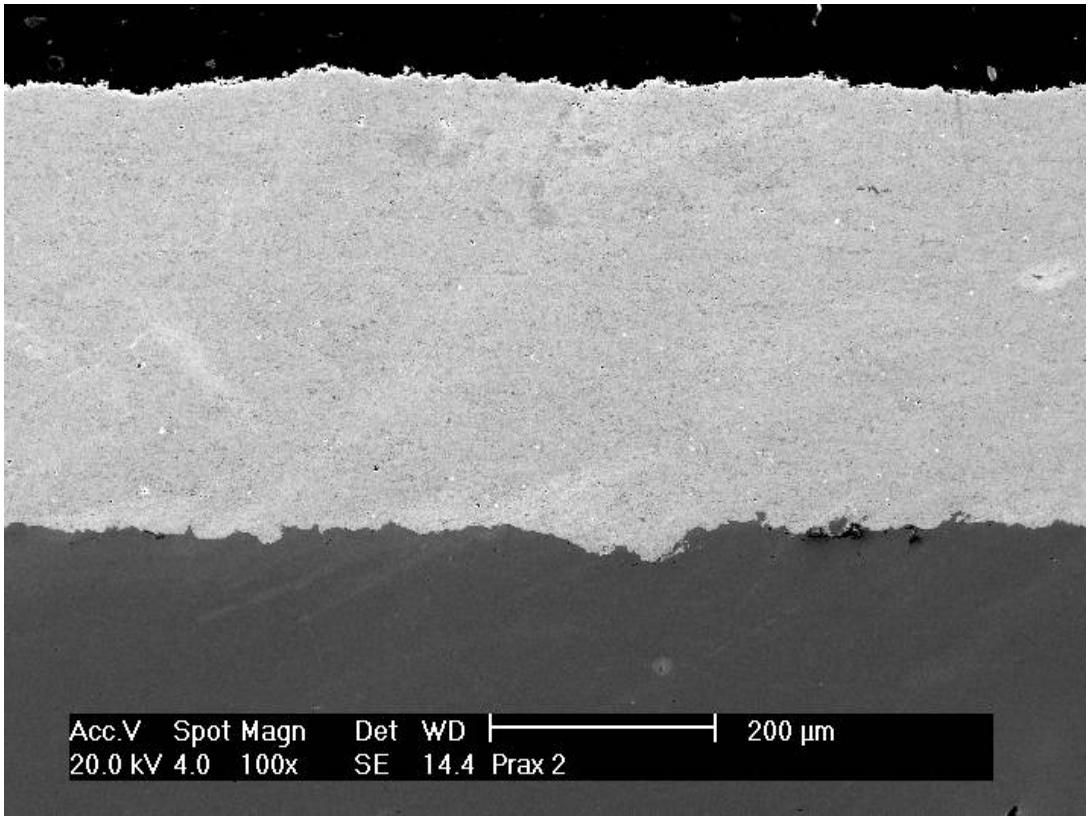

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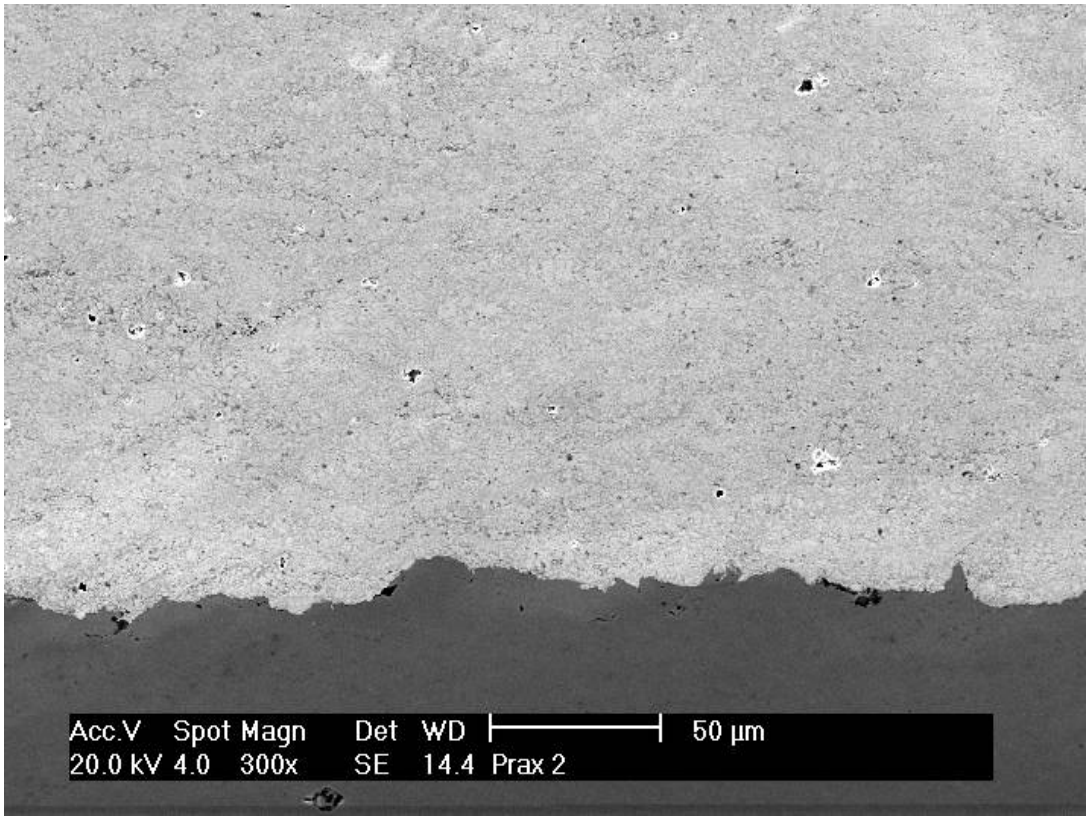

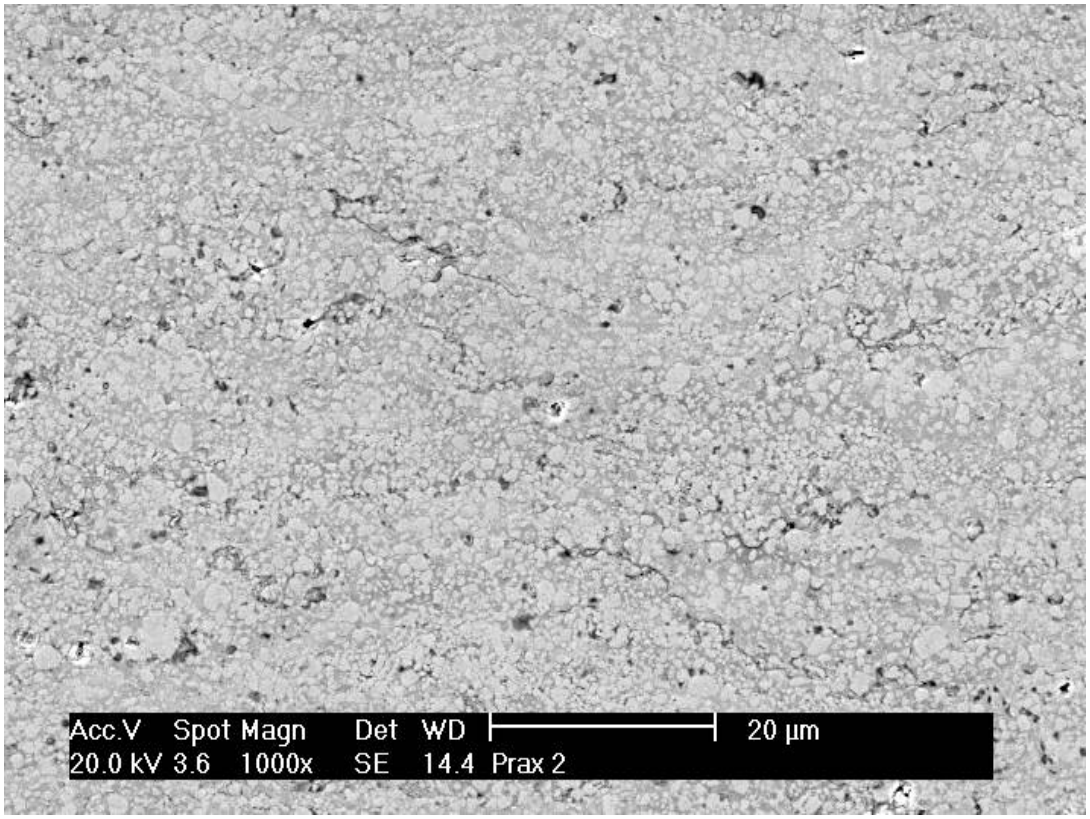

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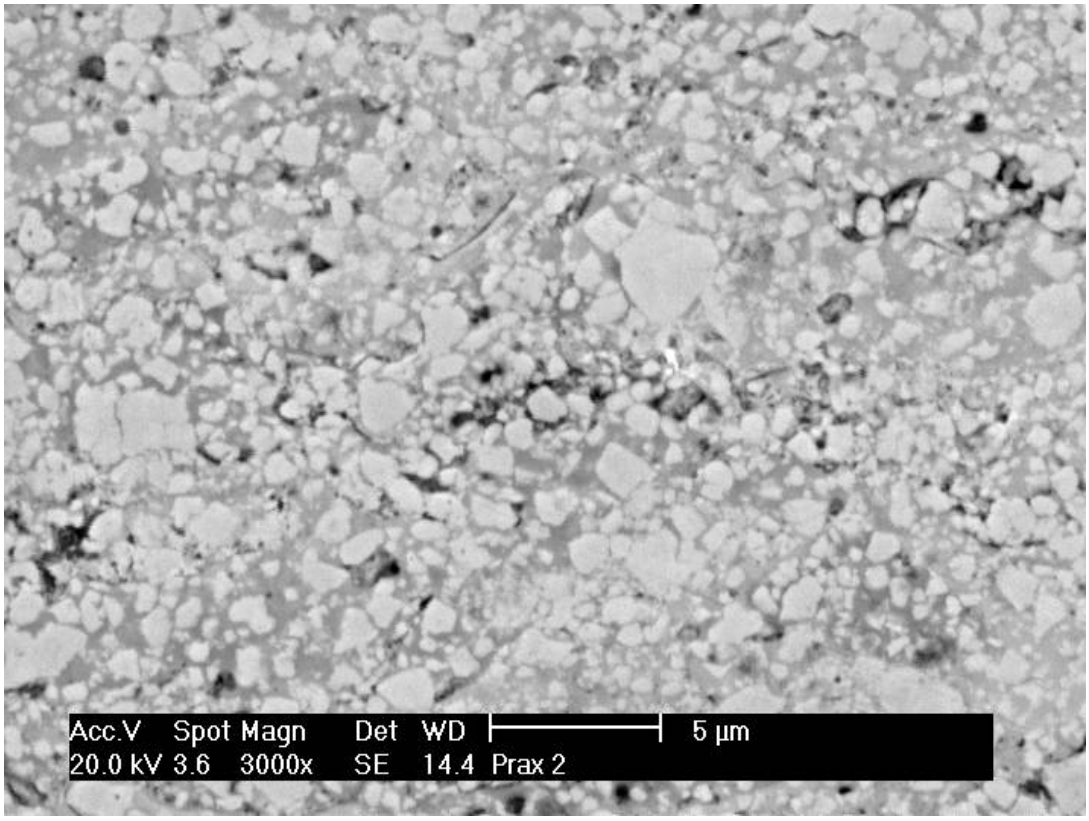

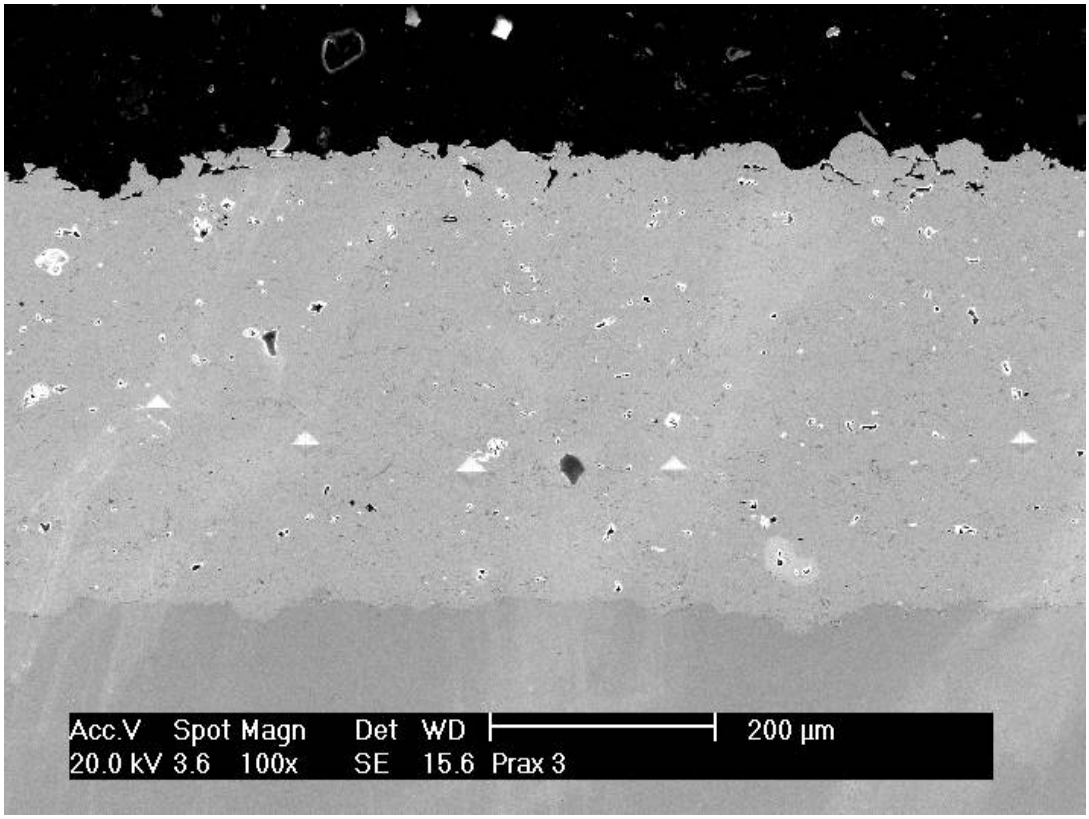

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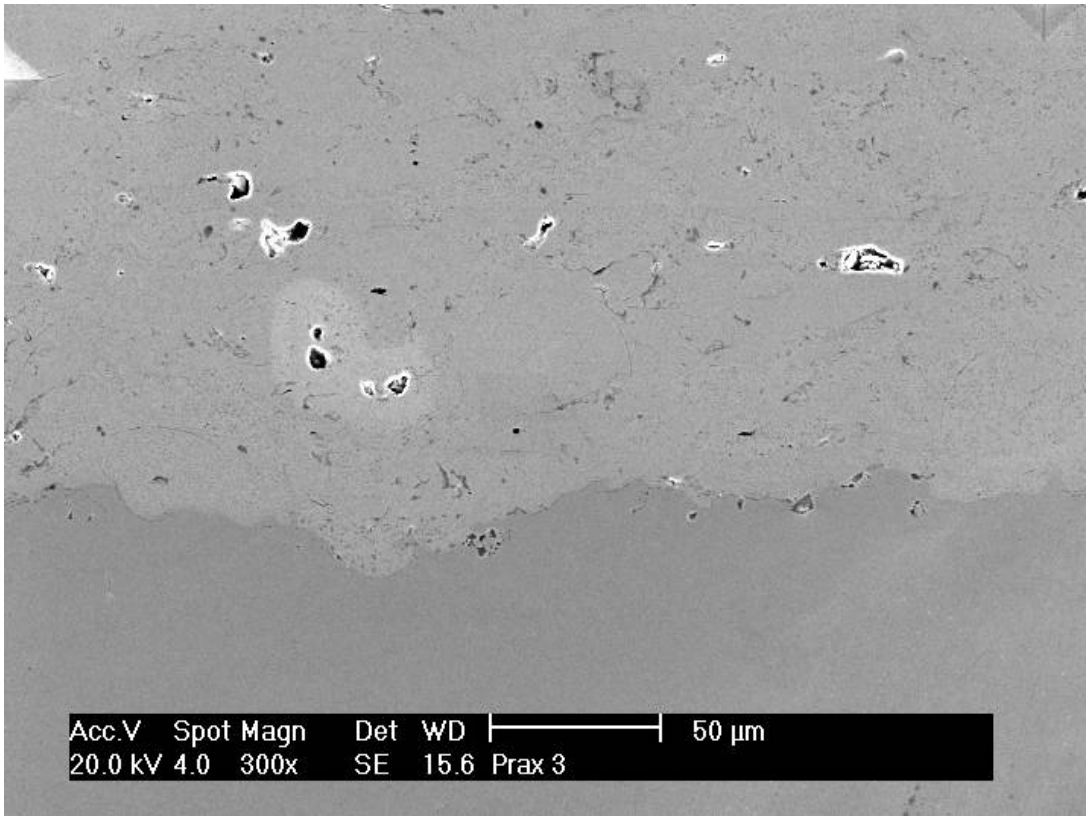

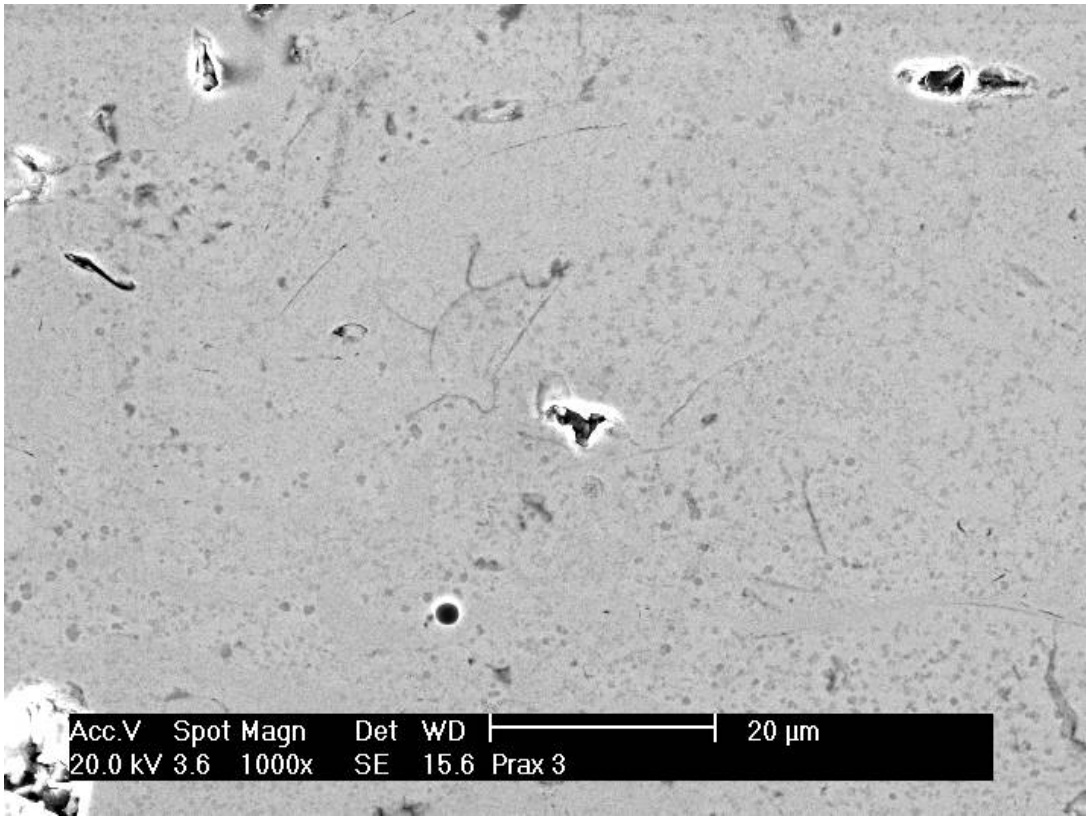

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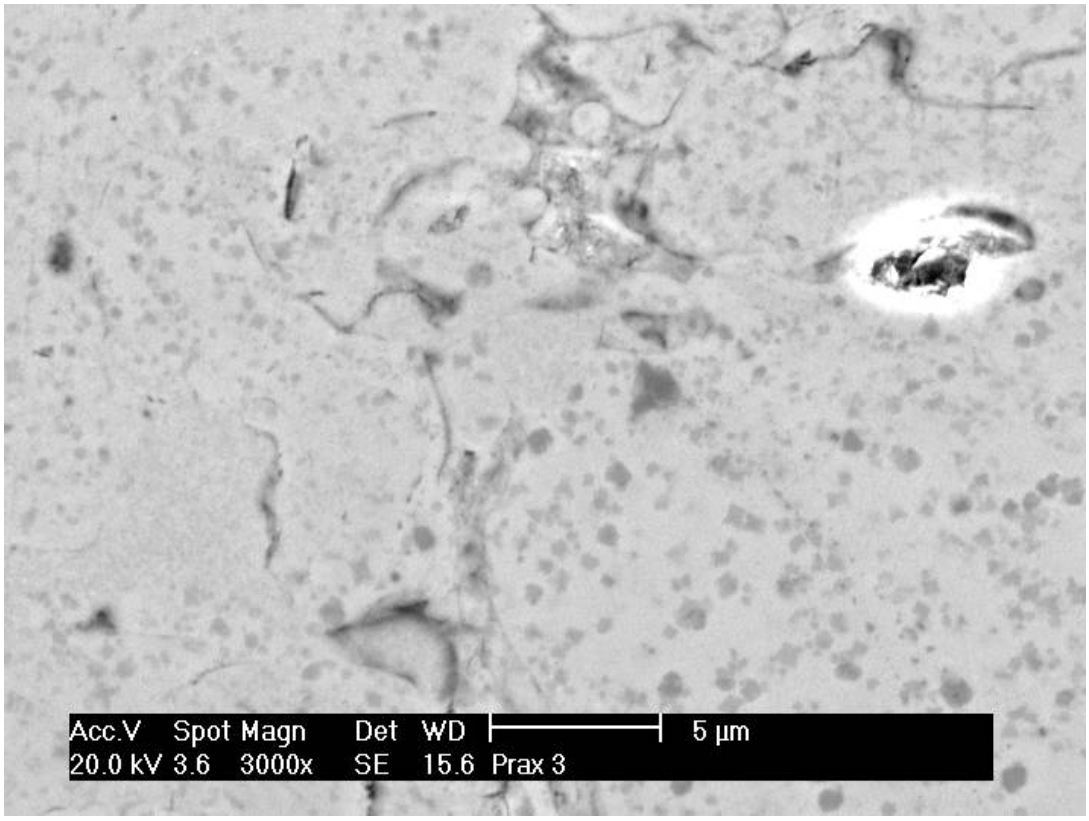

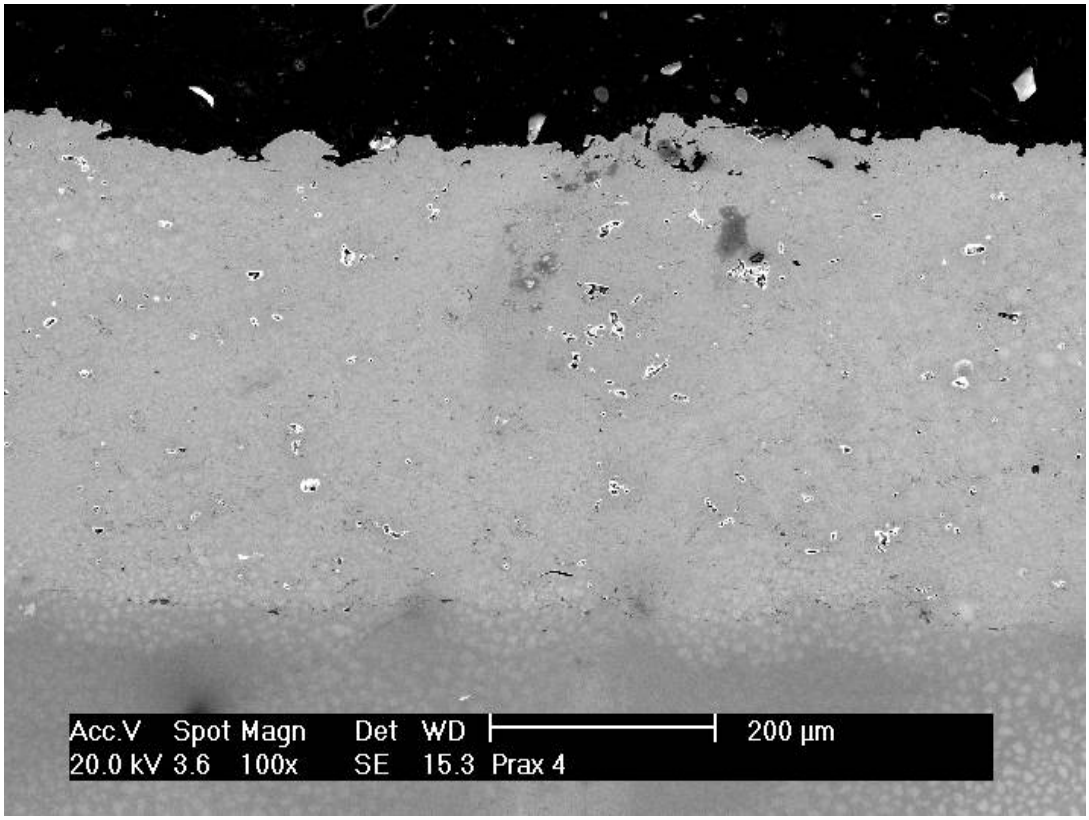

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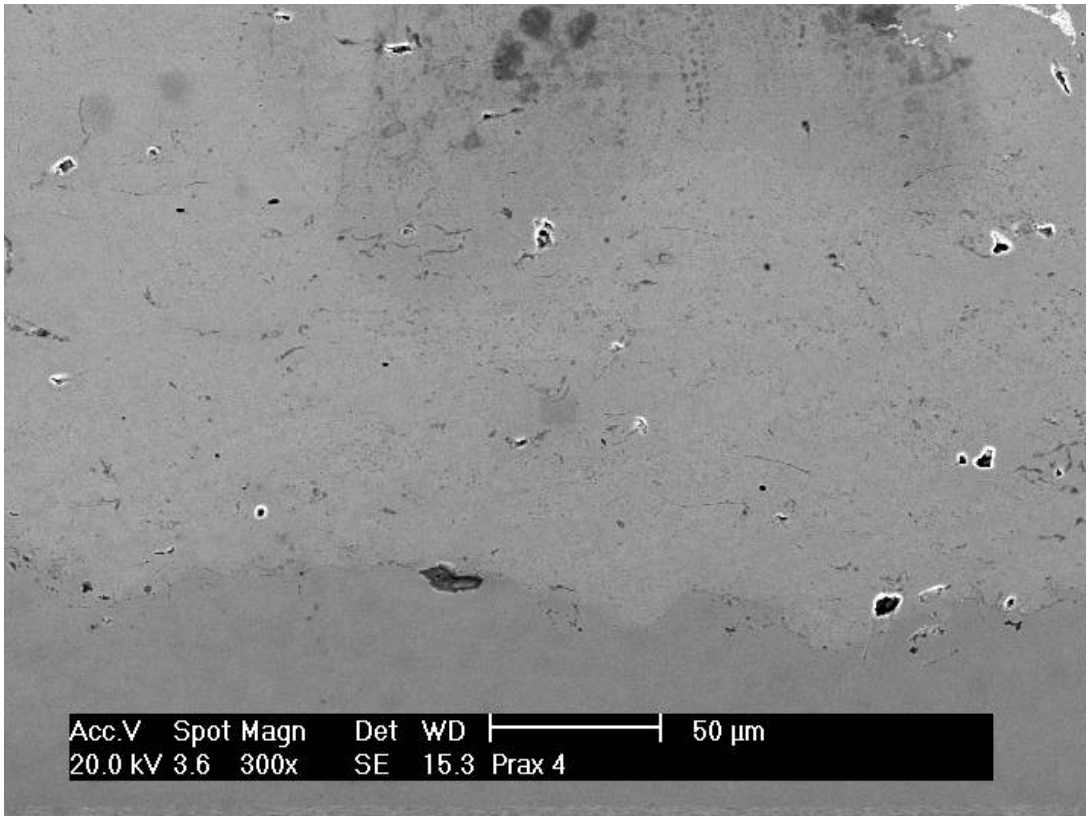

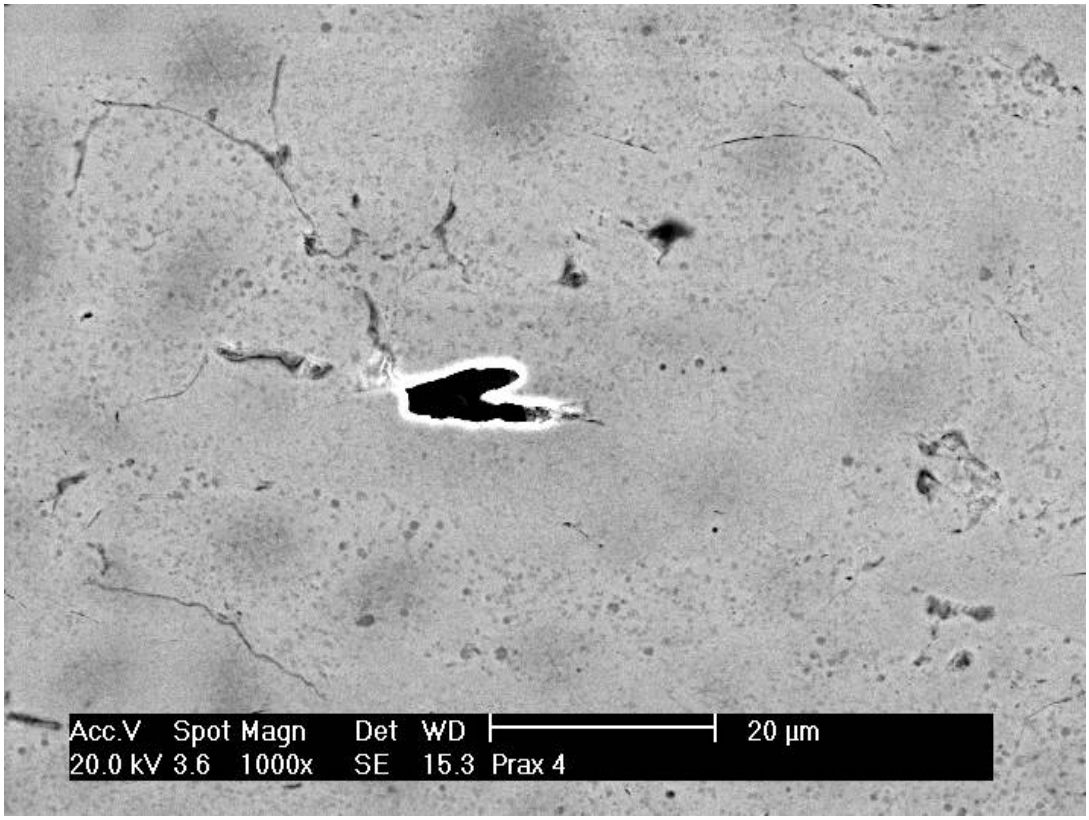

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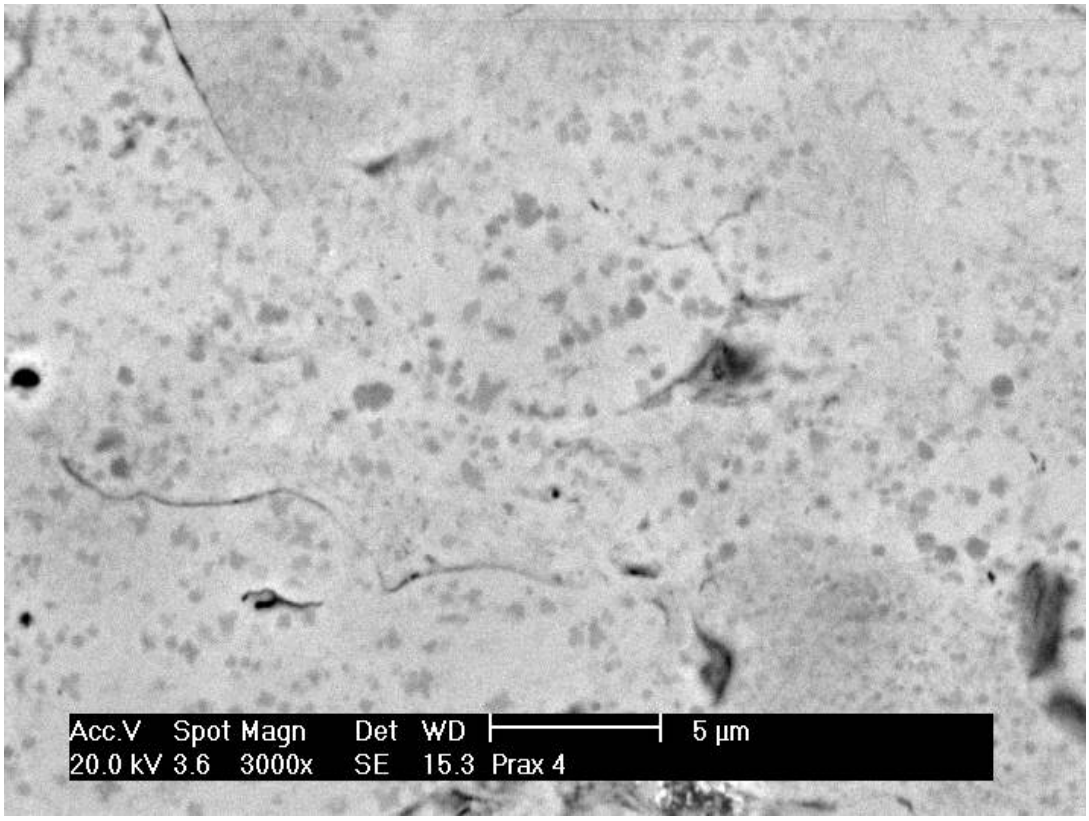

Summary of SEM micrographs: The Prax1 and Prax2 coatings showed homogeneous carbide distribution and augmented the dense structure with low porosity (less than 1 %) as seen also in optical micrographs.
The Prax3 and Prax4 coatings showed typical structure of HVOF sprayed NiCrBSi coating with a porosity of the order of 5%.

2.4 Tensile bond strength

Tensile bond strength of the coatings was higher than 75 MPa, which was the bond strength of glue used for testing adhesion.

2.5 Rubber-wheel abrasion test

Could not be carried out due to too small samples.

3 Summary

The WC-Co-Cr coatings obtained from UniqueCoat Technologies and Praxair Surface Technologies were manufactured from the 1350 VM powder. The coatings were about similar in hardness; of the order of 1350 $HV_{0.3}$. The porosity of the coatings manufactured by UniqueCoat Technologies was lower than that of coatings deposited by Praxair Surface Technologies as can be seen from optical and SEM micrographs.
Abrasion wear resistance was evaluated only with the coatings delivered by UniqueCoat Technologies and they showed very high wear resistance in the rubber-wheel abrasion test.

The 1275H (NiCrBSi) coatings were obtained only from Praxair Surface Technologies. They had hardness of about 800 $HV_{0.3}$ and higher porosity as compared to WC-Co-Cr coatings.

Tensile bond strength of all the tested coatings was higher than 75 MPa, which was the bond strength of the glue used for testing adhesion.

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