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This information was originally contained in the February 13, 2009 submittal as:

ATTACHMENT INTERTEK 1

ATTACHMENT

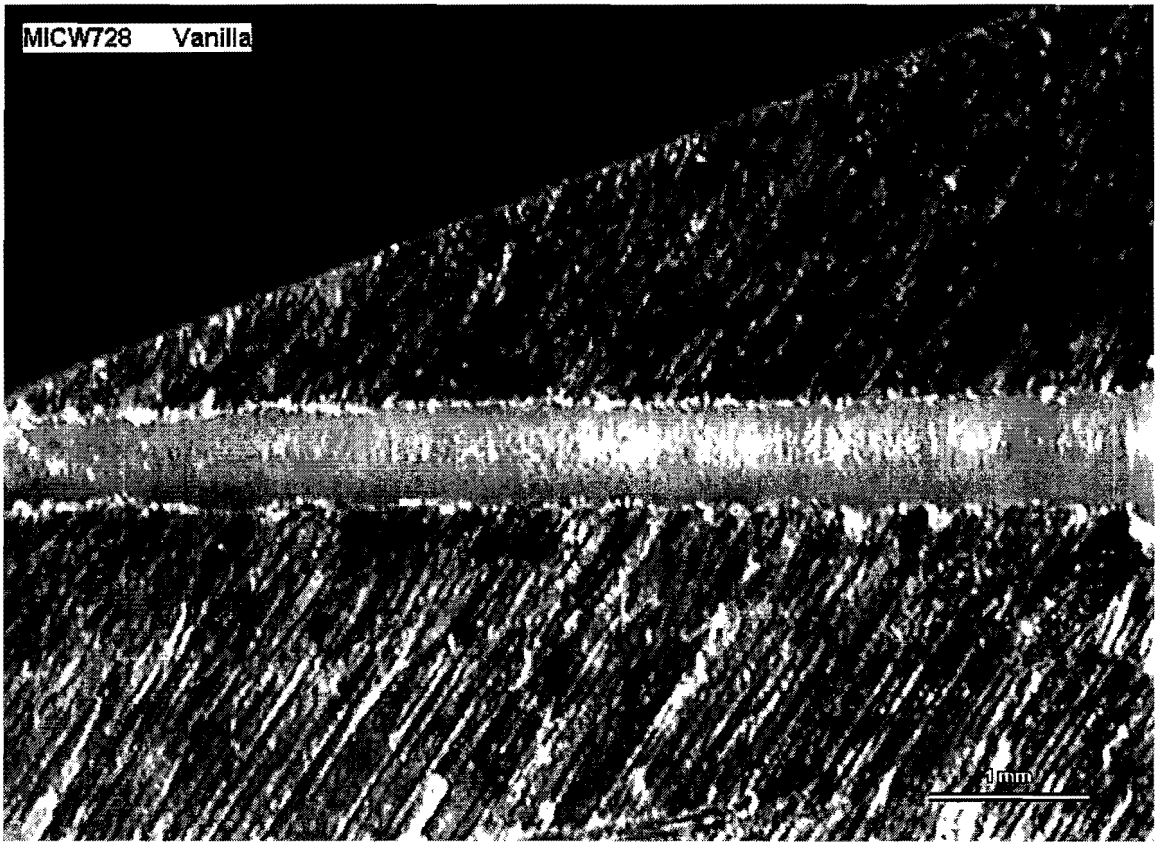
INTERTEK 1

Analysis of wedge block and debris

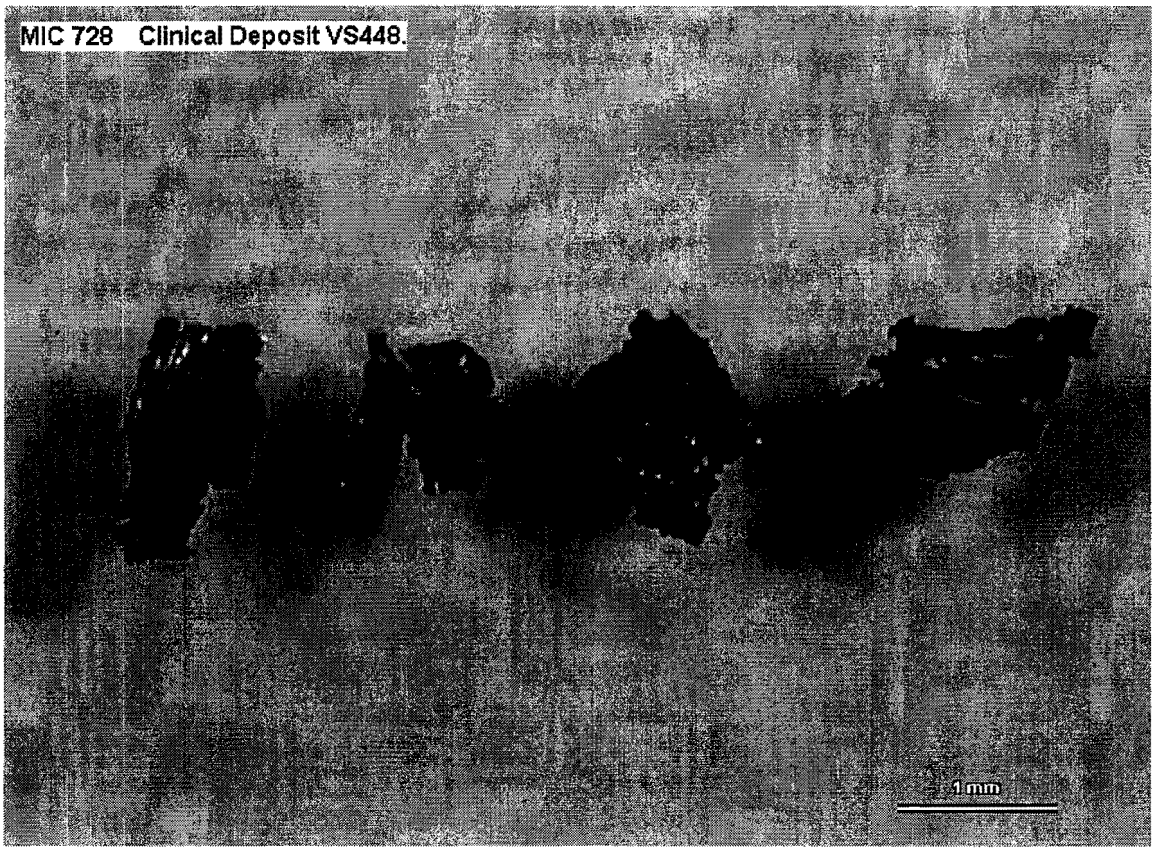
Excerpts from the Intertek study on the wedge block and debris

Results, Interpretations and Opinions

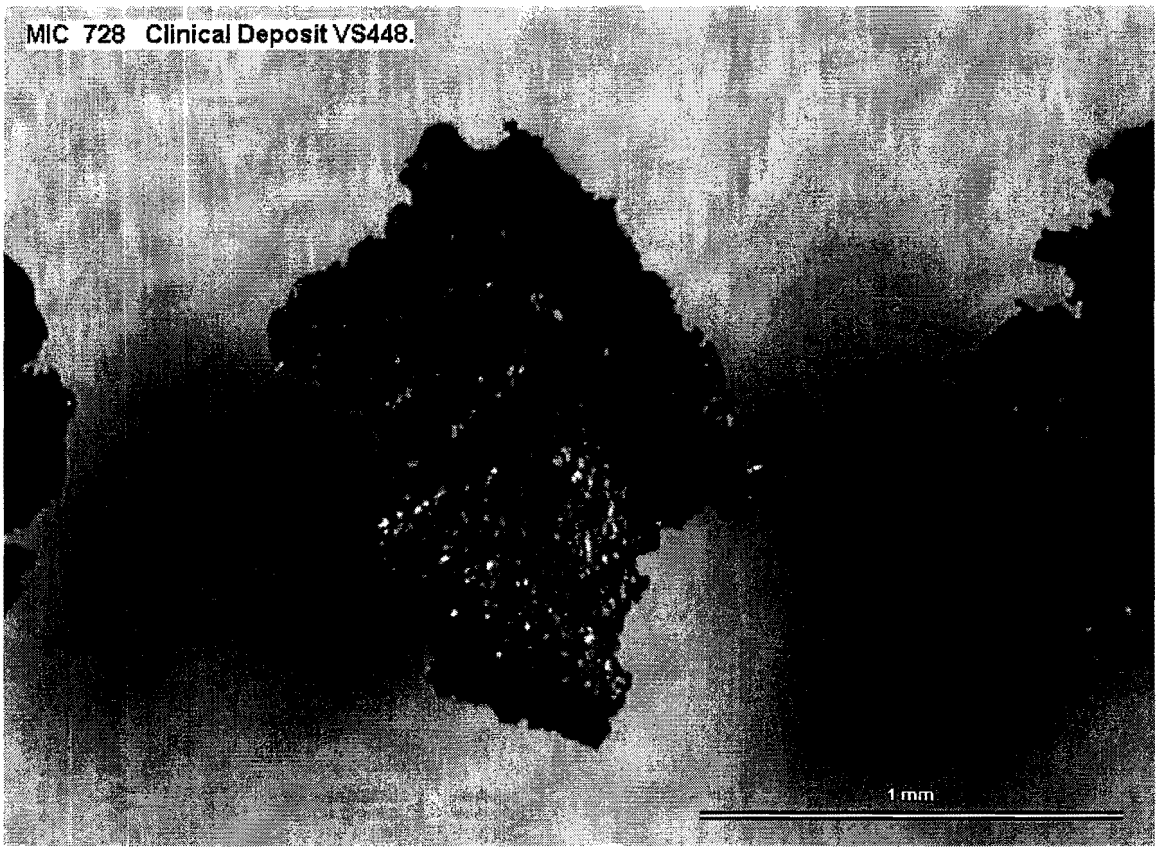
The work under review was carried out in the electron microscopy building using the techniques of industrial forensic science. In this case stereomicroscopy, polarised light microscopy and SEM / EDX (Hitachi S2700) were utilised. On one occasion a crystalline melting point was obtained and this is not included within the scope of UKAS accreditation.



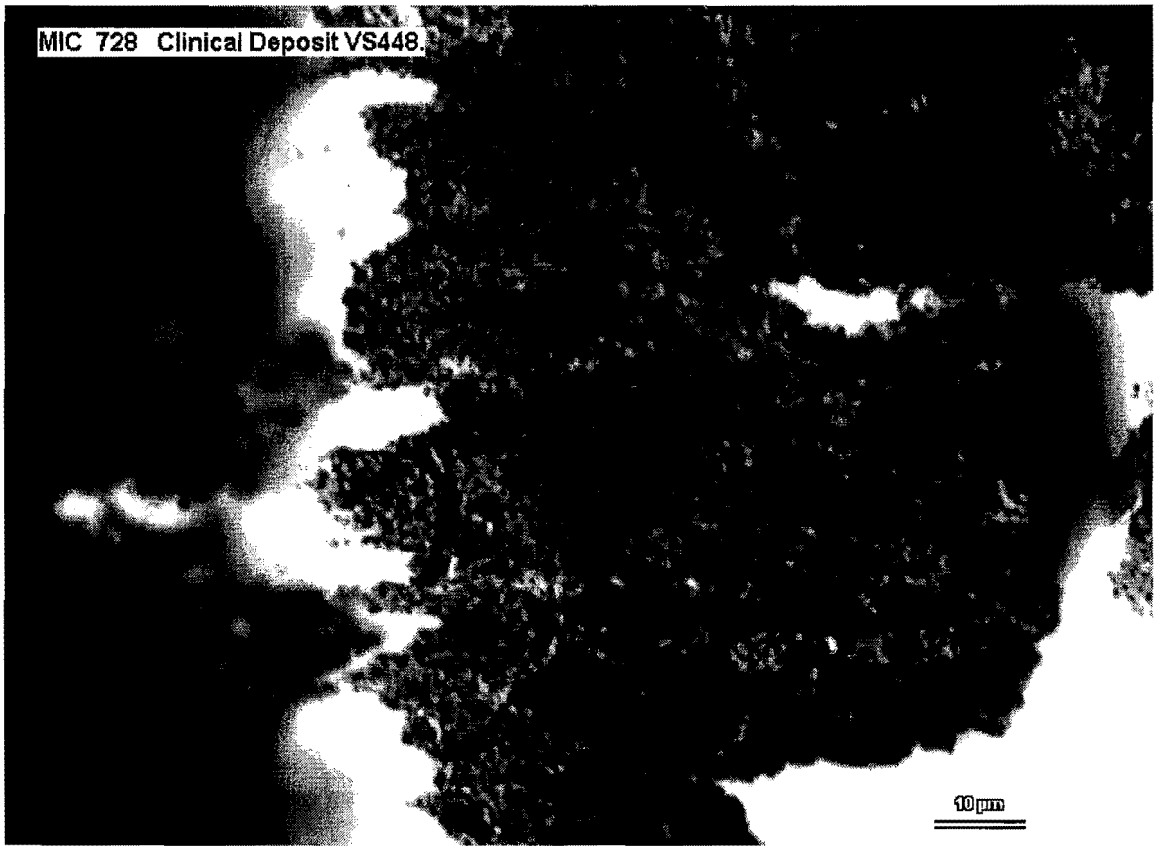
The above image illustrates a cross section of a "vanilla" or unused reference block. The internal surfaces are "clean" and free from black deposits. We noted a thin coating of a clear transparent material on the surface and this is thought to be from the chemical pre-treatment. This surface coating inside the bore is brittle and glassy.



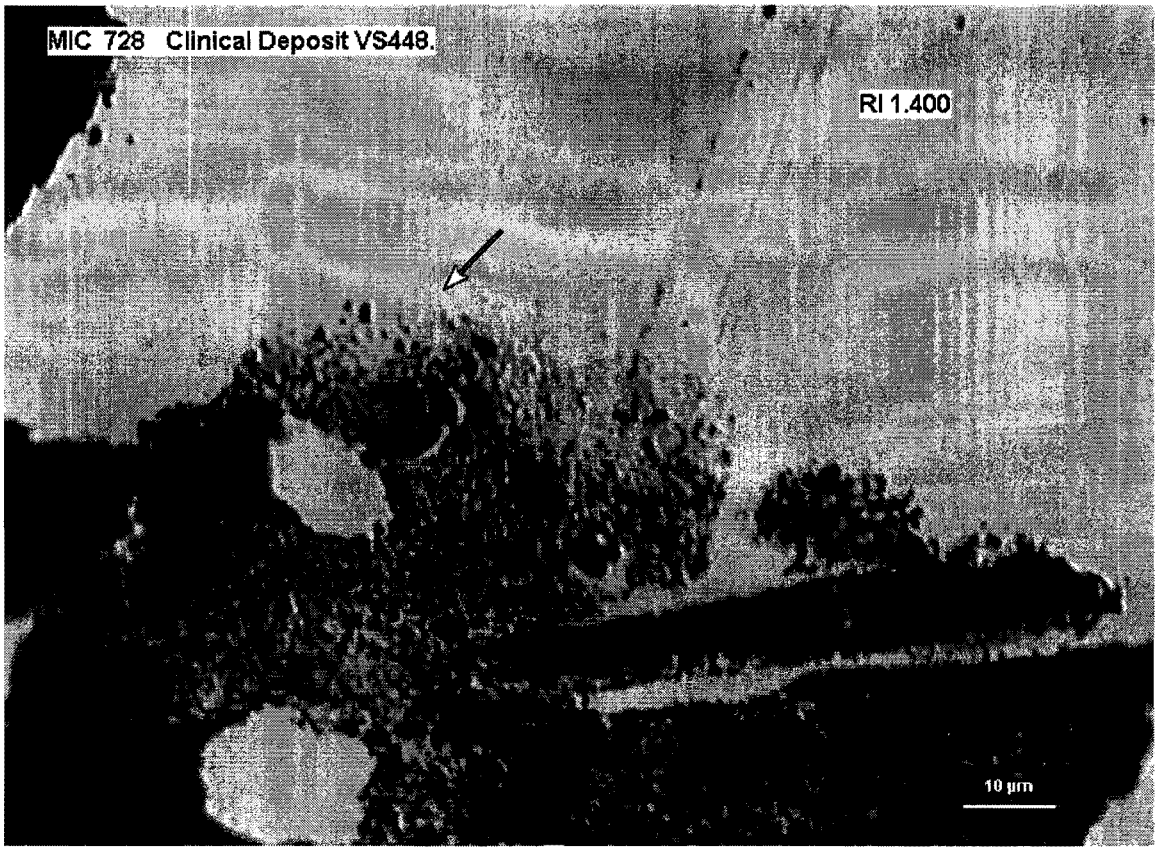
The clinical deposit was removed from the package and found to be very homogeneous. All the particles were very similar and there was little evidence of any other "extraneous" contamination such as fibres, mineral particles and general "office dust". The above image is very characteristic of all the particles in the package.



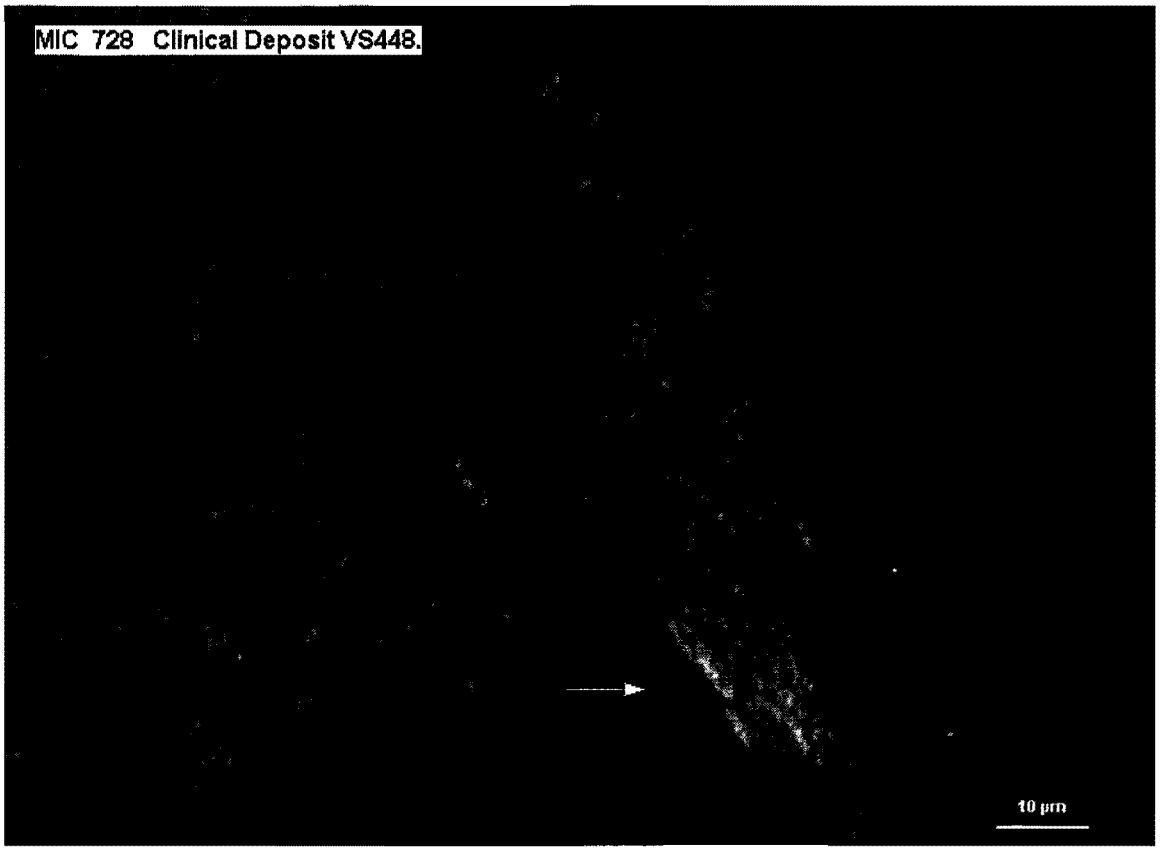
At higher magnifications the curved morphology of the particles is visible and this appears to be material that has been attached to the bore – where the wire has been rubbing on the upper surface in the particle above.



In thin section the particle is comprised of a soft transparent continuous phase which is impregnated with opaque black debris. The particle size of this debris can be determined with reference to the attached scale bar (10 microns).



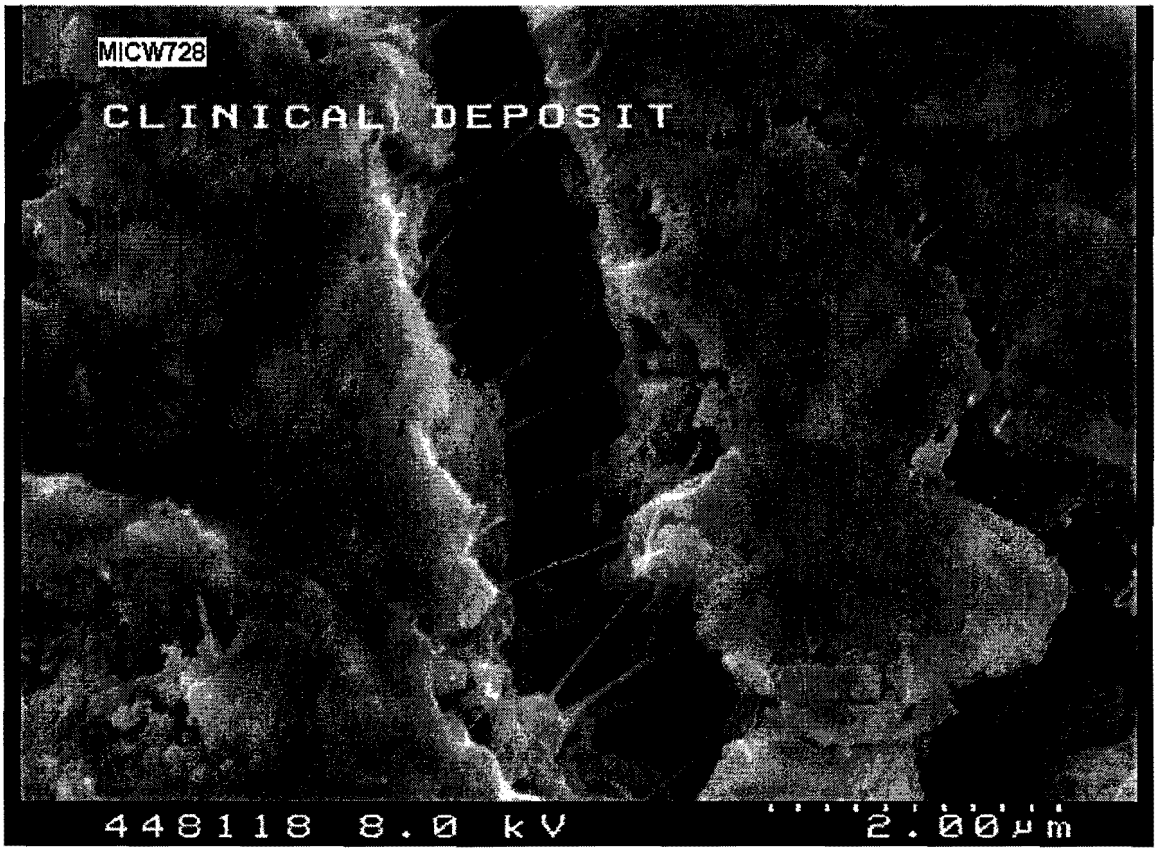
Using a refractive index liquid of 1.400 the soft transparent continuous phase reveals itself as having a low refractive index (in common with fluoropolymers for instance).

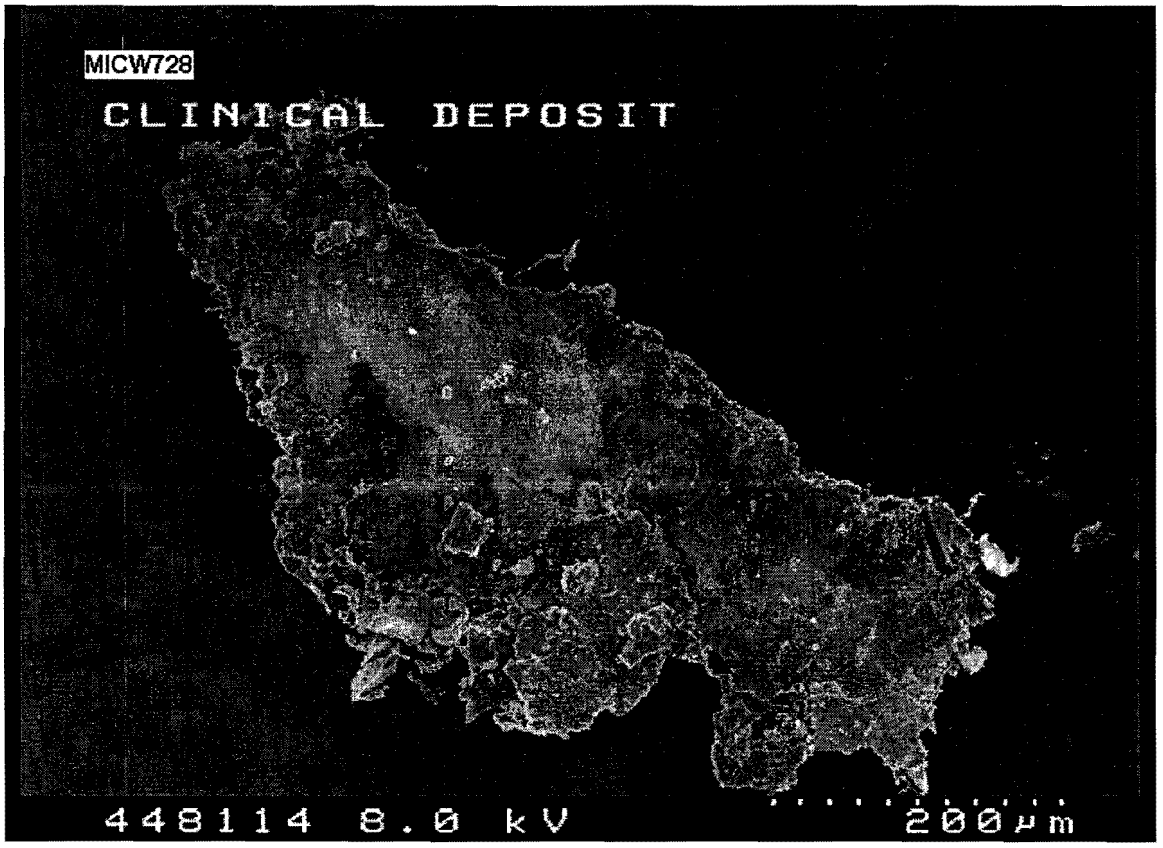


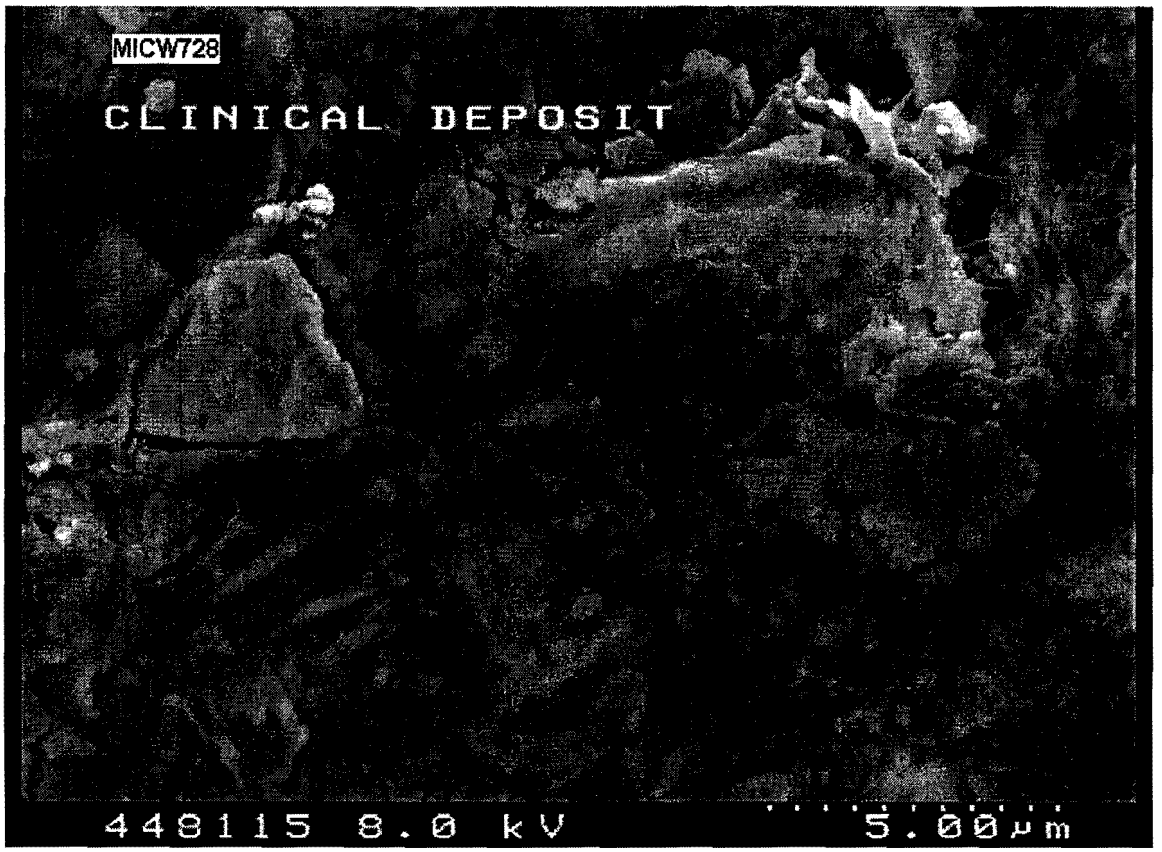
Using polarised light microscopy the continuous phase exhibits a low birefringence in this section – again a common feature of fluoropolymers. A hot stake microscopy experiment (Non UKAS) reveals that the melting point of this birefringence is very high (in excess of 300 degrees). This is further evidence of a high melting point polymer phase that binds the black opaque particles together.

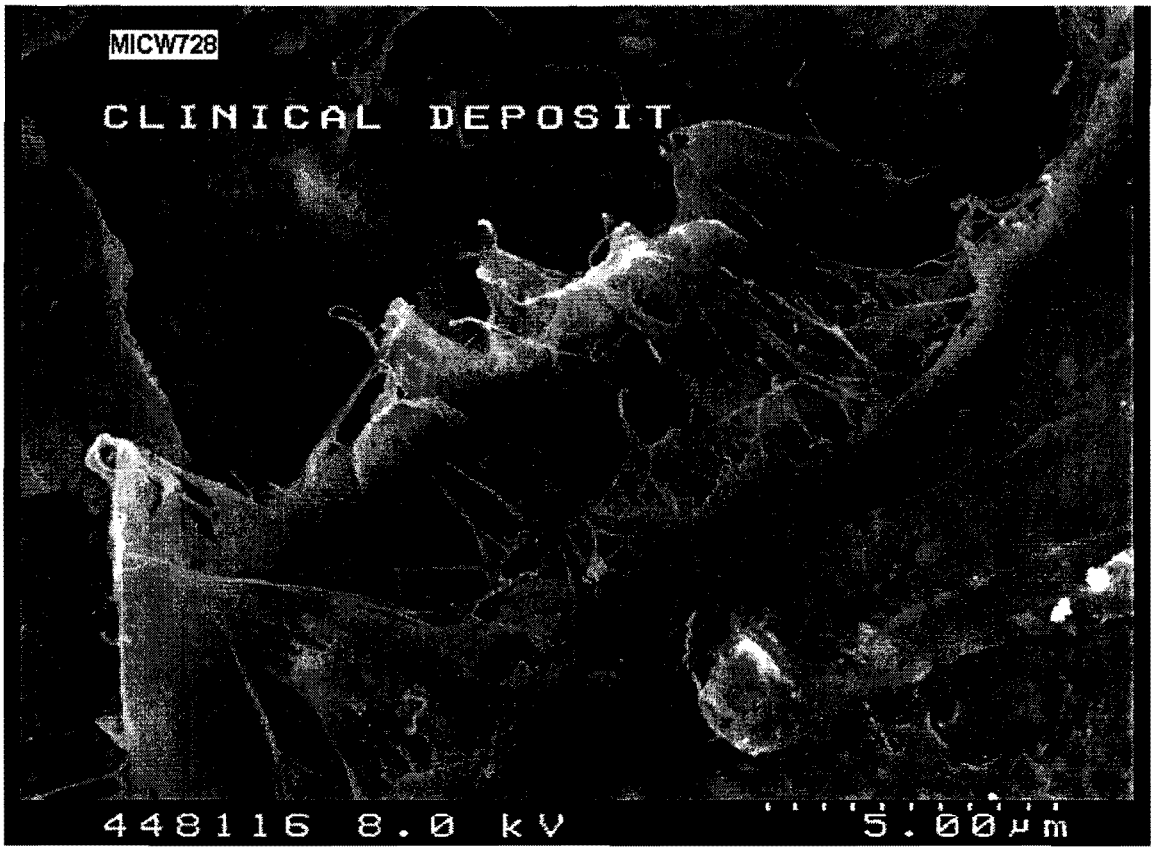
What follows is a sequence of SEM / EDX spectra that gives a "fingerprint" of the inorganic material comprising the particles illustrated above. Characteristically, the particles contain Fluorine (probably the Fluoropolymer matrix). Titanium and Nickel are also detected and this appears to be due to fine particles entrained in the continuous phase. [redacted]t the black debris in the light micrographs are representative of this material which is likely to be wear debris. Traces of Iron were noted in many of the particles examined and on searching individual particles we noted small particles of Iron / Chrome / Nickel containing material – probably stainless steel. Occasionally we noted small Sulphur and Silicon peaks.

We therefore postulated that the clinical deposit was a soft fluoropolymer that has acted as a binding agent for wear debris from [redacted]nd other parts of the machine.


MICW728
CLINICAL DEPOSIT
448118 8.0 kV
2.00µm


MICW728
CLINICAL DEPOSIT
448114 8.0 kV
200µm


MICW728
CLINICAL DEPOSIT
448115 8.0 kV
5.00µm

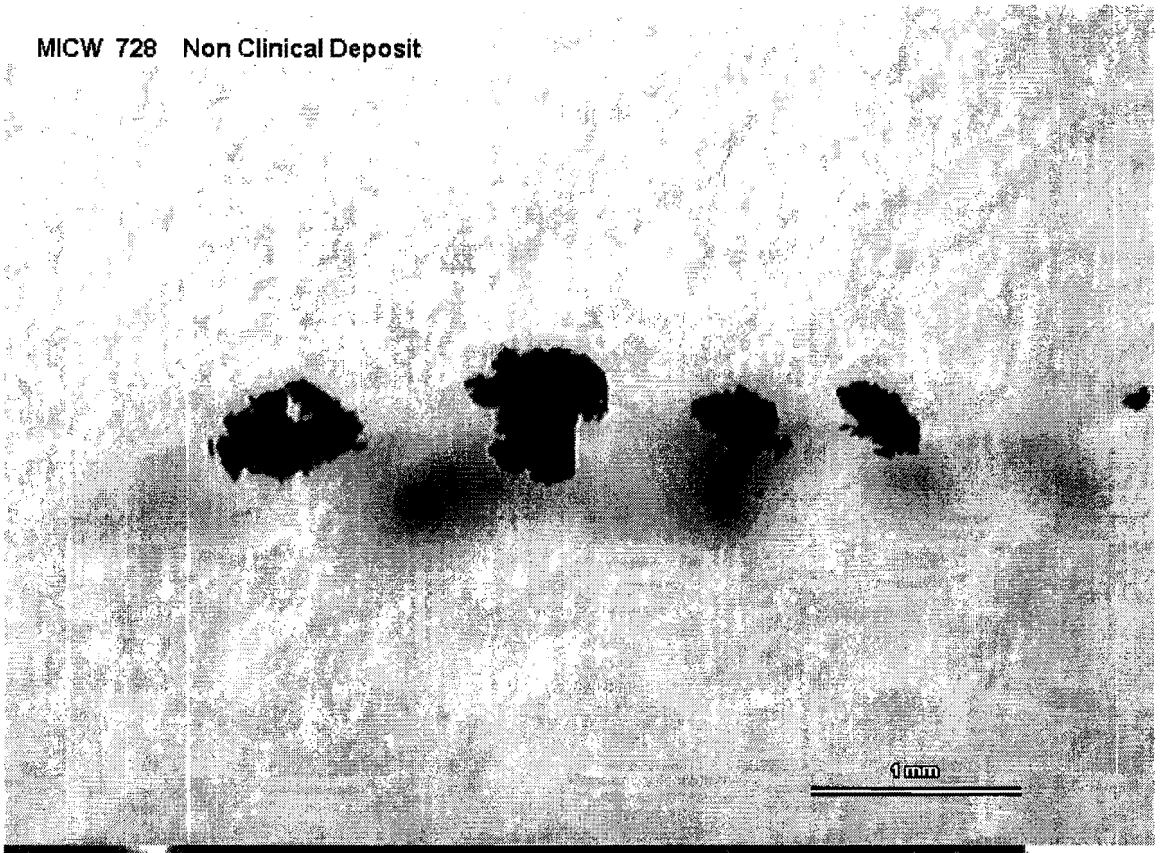

MICW728
CLINICAL DEPOSIT
448116 8.0 kV
5.00µm


MICW728
CLINICAL DEPOSIT
448117 8.0 kV
3.00µm

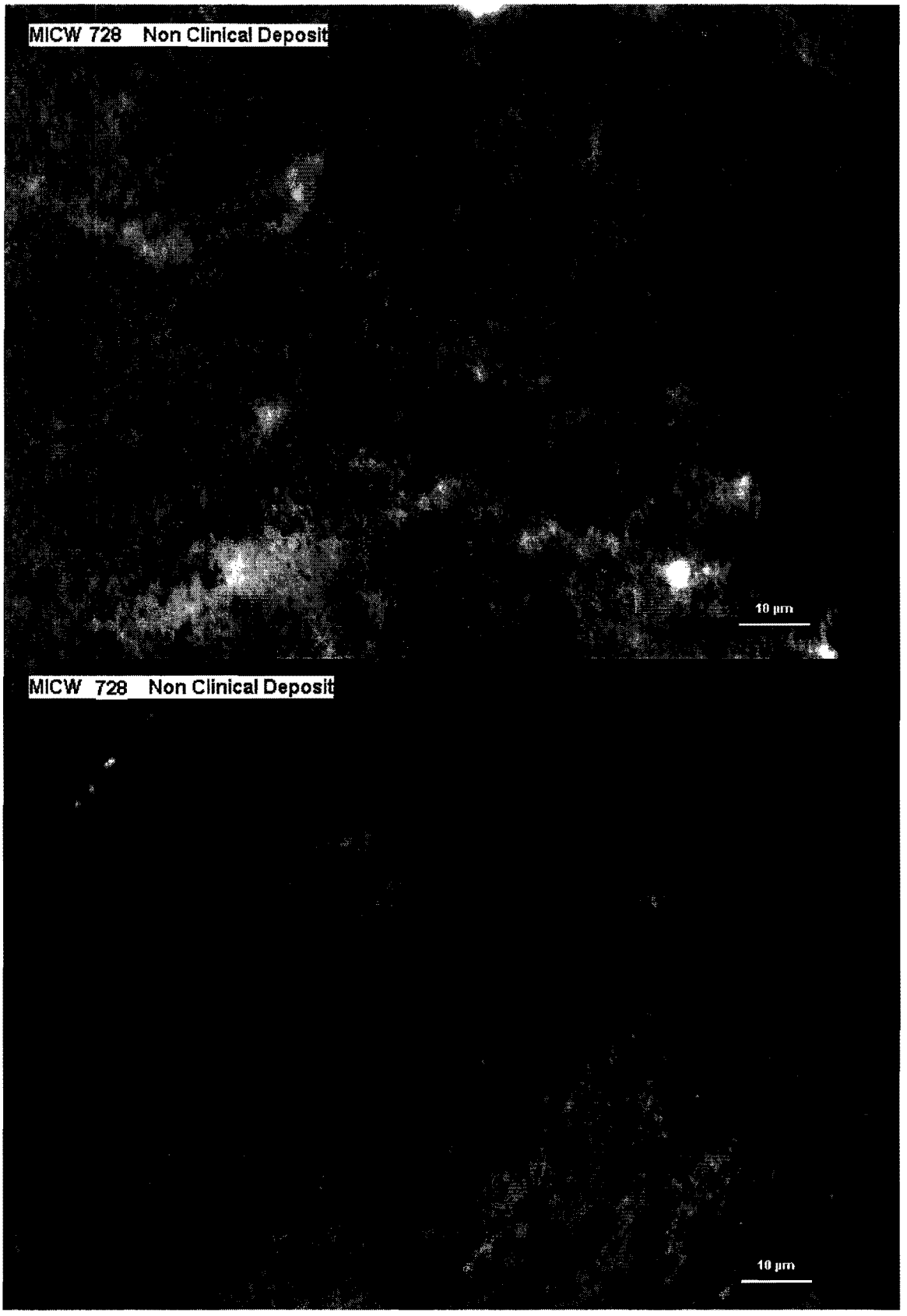
The black and white images above are high resolution FESEM images and characterise the clinical deposit well.

The "soft" transparent continuous phase is prone to fibrillation – it is basically a "sticky" material that deforms under shear – similar to PTFE. The particles visible in this continuous phase are the wear debris identified as largely bei[redacted] the previous EDX spectra.

What follows is a similar investigation into the "non clinical" deposit as supplied to us. The similarities to the clinical deposit are striking.

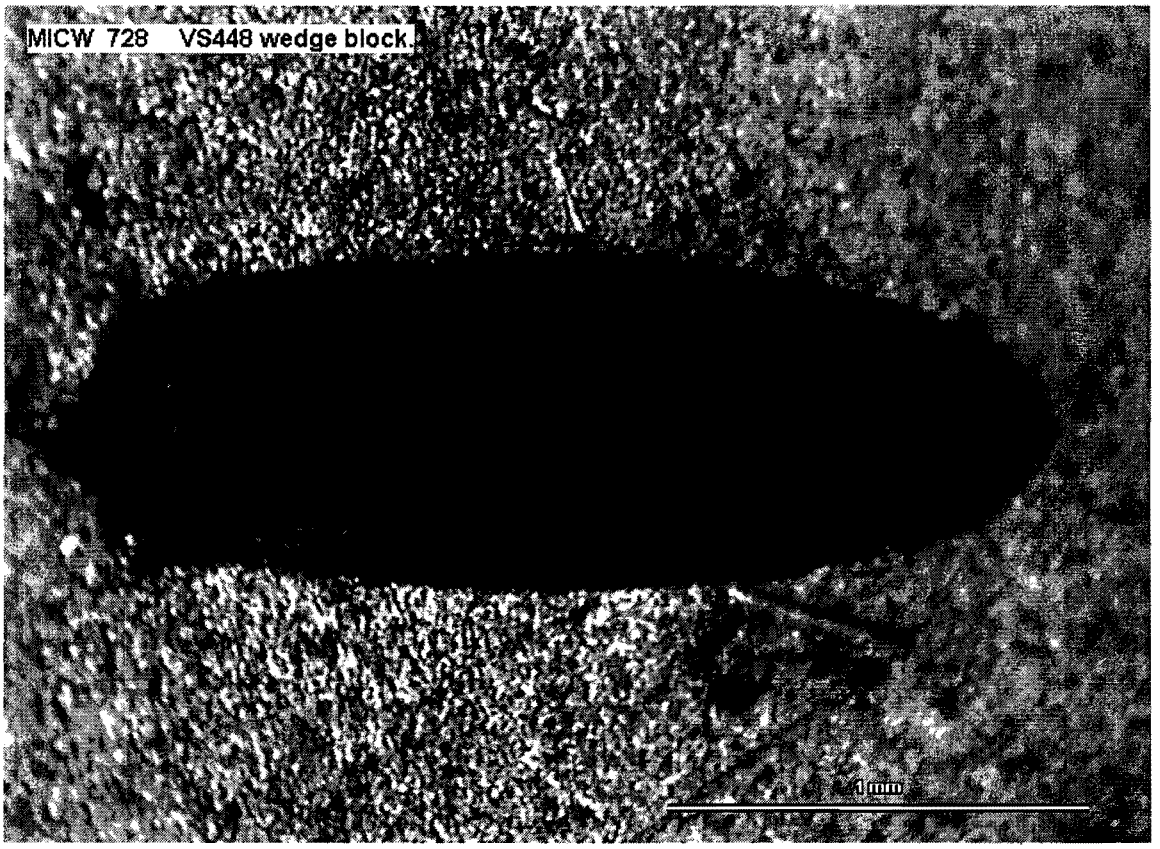

MICW 728 Non Clinical Deposit
1 mm

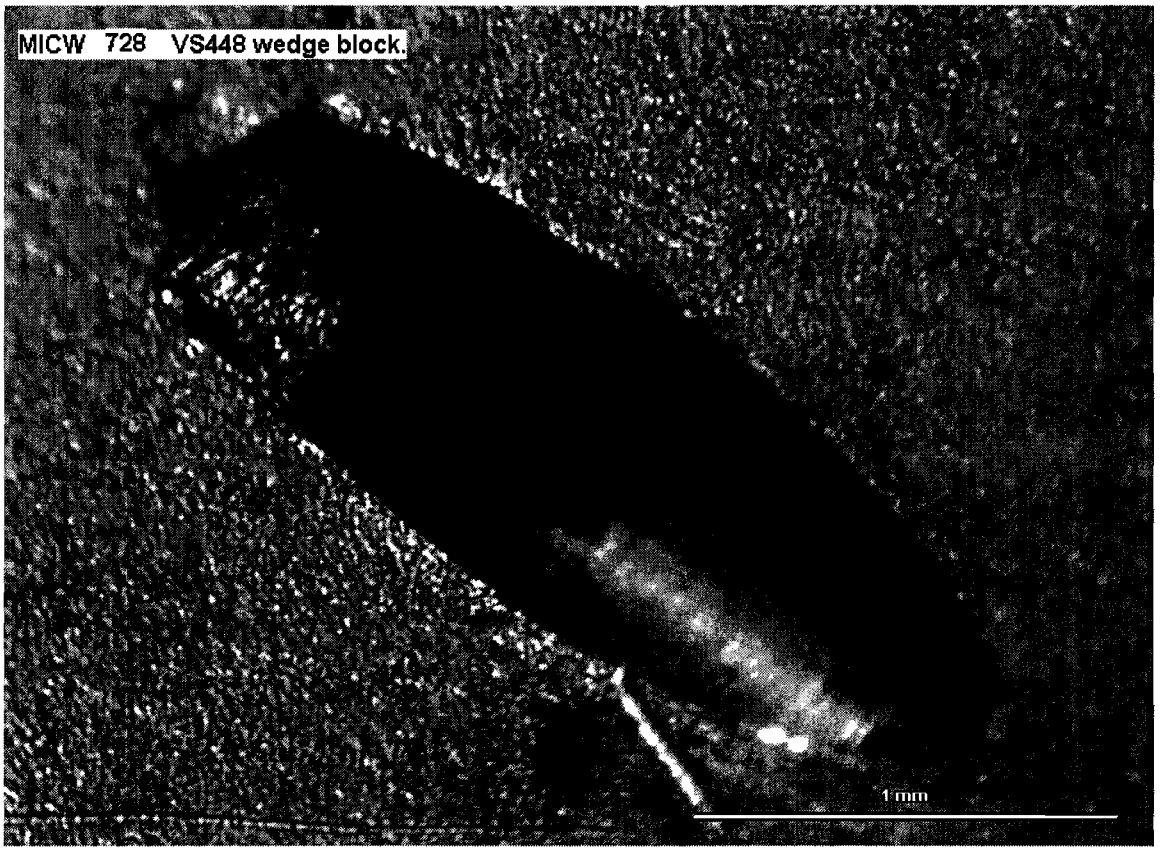

MICW 728 Non Clinical Deposit
10 µm

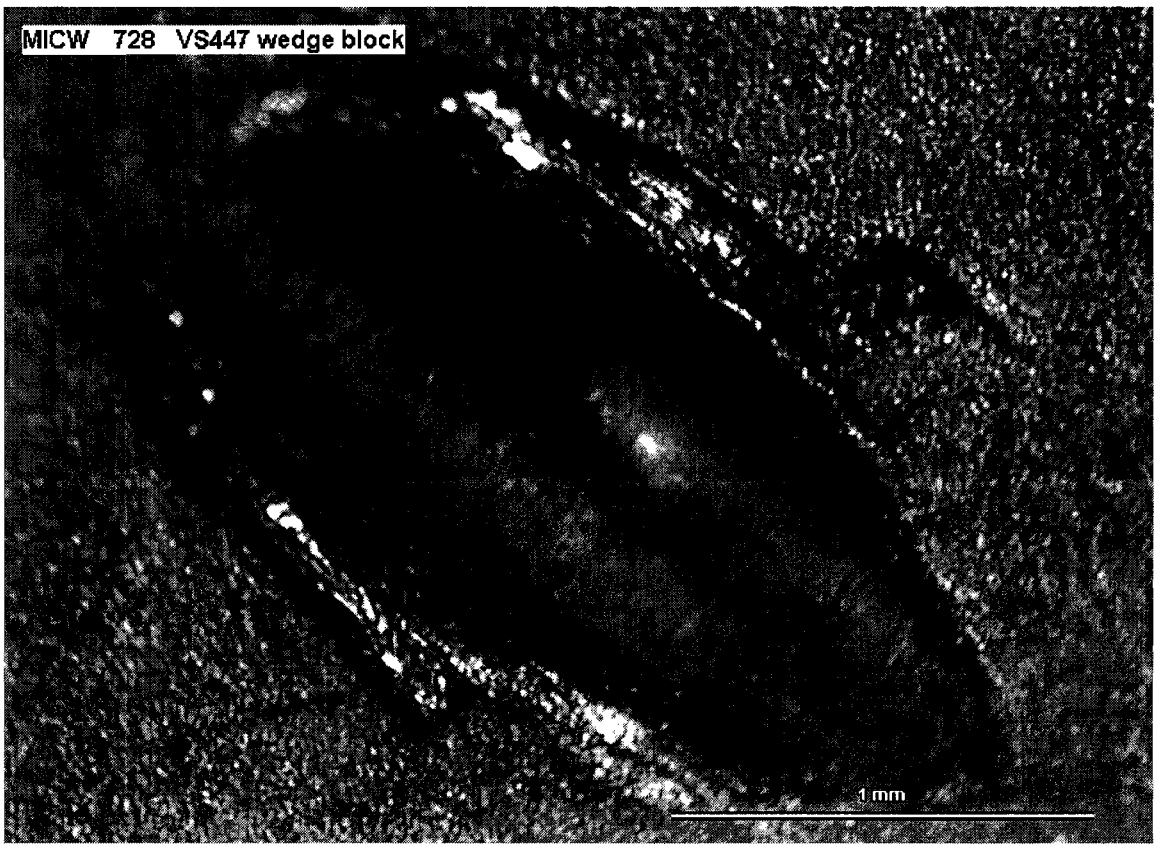

MICW 728 Non Clinical Deposit
10 µm
MICW 728 Non Clinical Deposit
10 µm

From the above work we conclude that the clinical and non clinical deposits are to all intents and purposes the same.

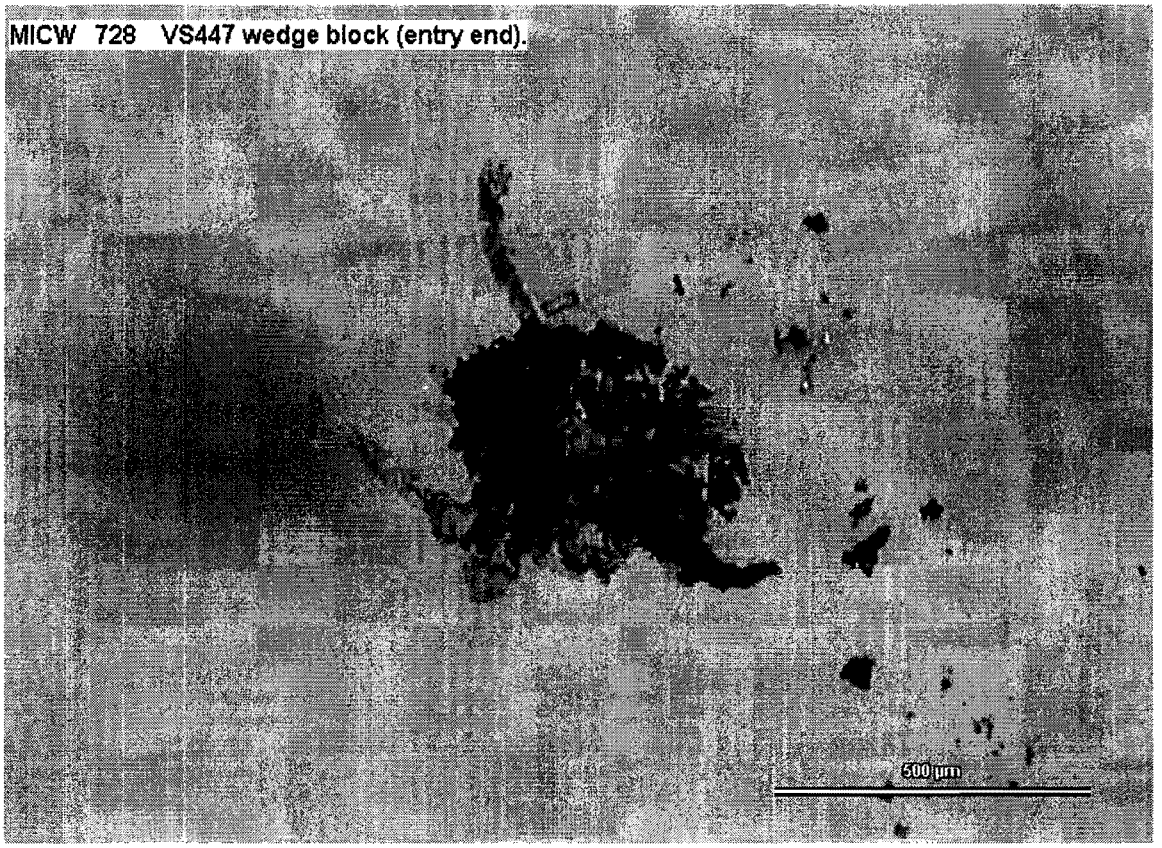
What follows is an attempt to realise a causal link between these deposits and the blocks as supplied to us. The same methodology being utilised as was detailed above. The only difference being that the blocks were photographed before manual dissection of the internal deposit took place.

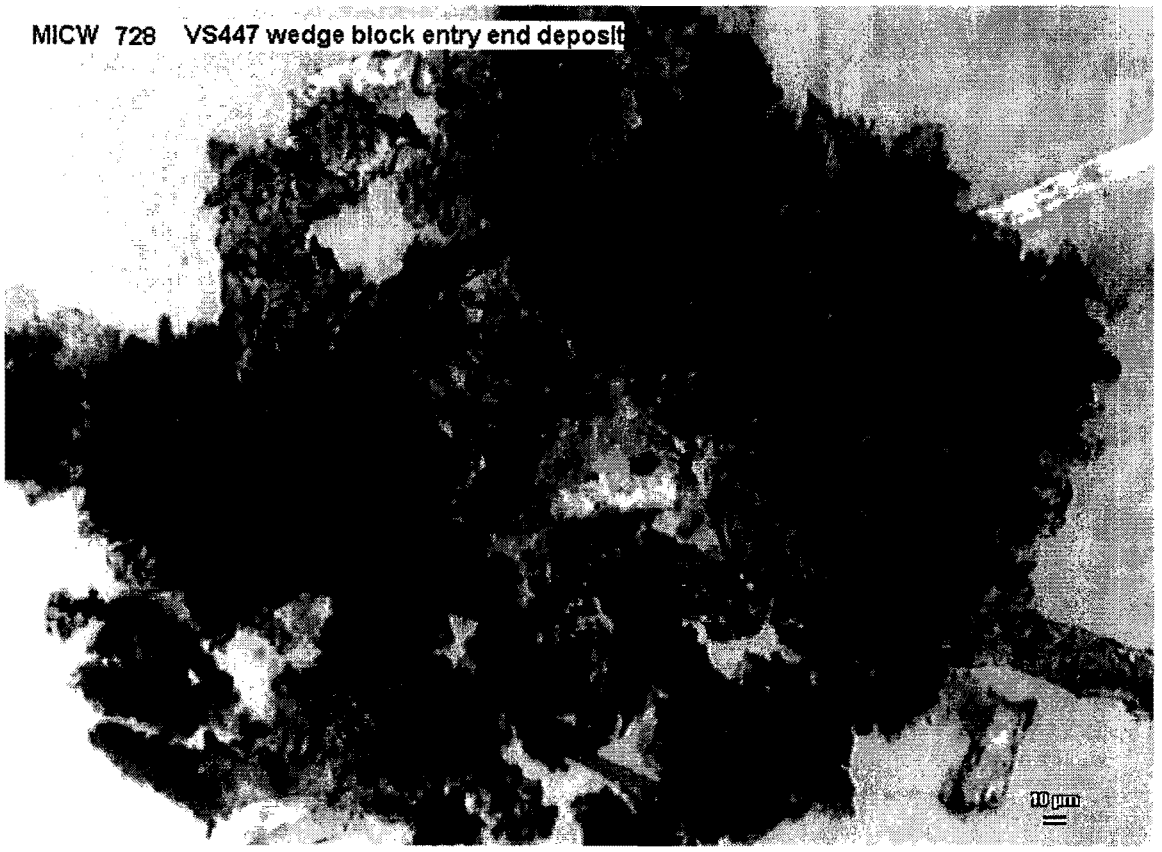


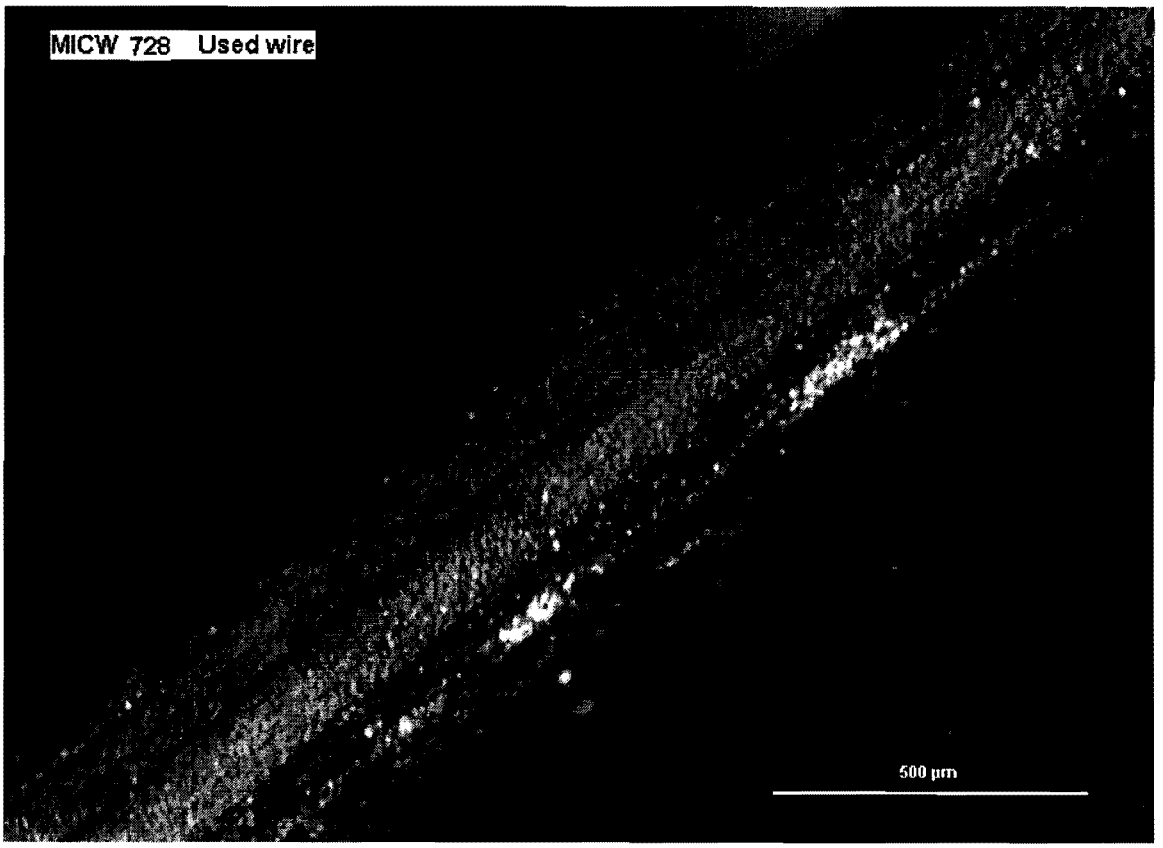

MICW 728 VS448 wedge block.
1 mm


MICW 728 VS447 wedge block
1 mm

The VS 447 block can be seen to be particularly clean. In this case we examined the entry point of the block and retrieved the deposit illustrated below.




MICW 728 VS447 wedge block entry end deposit
10 µm


MICW 728 Used wire
500 µm

In my opinion the wire has been handled and this has compromised the surface somewhat. This is characterised by the presence of Sodium, Sulphur, Chlorine and Potassium – which are often observed in association with fingerprints and handling debris.

Quite apart from this Fluorine, Titanium and Nickel are detected and this is characteristic of the clinical deposit.

In conclusion.

The deposits observed through out this study have many similarities. The internal bore of the blocks is compromised with a black deposit that this very similar to the clinical deposit – both in terms of chemistry and morphology.