Coating of NiCr with Plasma Coat Sputtering System **7th June 2012**

The object of this exercise was to determine the actual temperature at a substrate during the deposition of a NICr thin film. For a coating thickness of 440 nm, the customer required that substrates saw maximum temperatures of no more than 70 °C.

For this purpose iButton sensors and a new NiCr target was provided by the customer.

Preliminary trials with the iButton sensors showed that they were remarkably easy to program and use within a vacuum chamber. The particular iButton versions supplied to us could record to a maximum of 85 °C and comparison with a mercury-in-glass thermometer appeared to show reasonable correspondence – although a proper calibration remains to be done.

A new NiCr target was received on 6th June.

The target was fitted to the Plasma Coat sputtering system on 7th June.

The magnetron power for the run reported here was 900 W, with an argon flow of 18 sccm.

To ensure that the iButton was recording the actual temperature that a substrate would experience it was decided to coat the flat surface of the sensor itself. To this end an adapter was machined to hold the iButton on the rotor of the drum as shown in the photo below (Fig 1) (prior to coating).

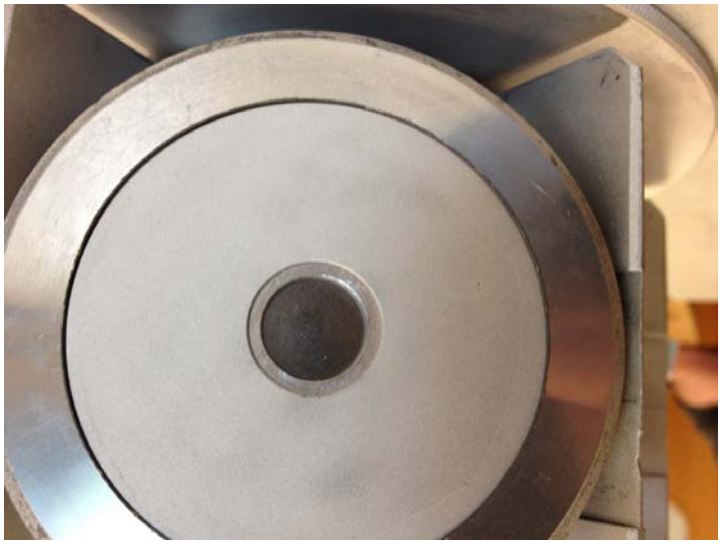

Fig 1 iButton sensor installed in substrate position on Plasma Coat substrate rotor

In order to measure the thickness of NiCr deposited, a glass micro slide was also mounted on the rotor.

As the deposition rate for NiCr was unknown, a 30 minute run was programmed in the machine.

Fig 2 shows the IButton sensor after coating and Fig 3 shows the micro slide after coating.

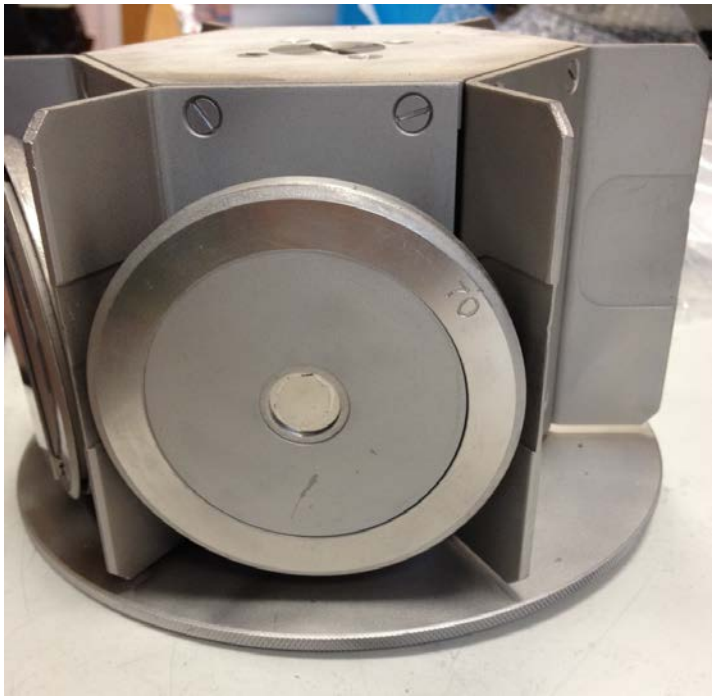

Fig 2 iButton sensor after NiCr coating

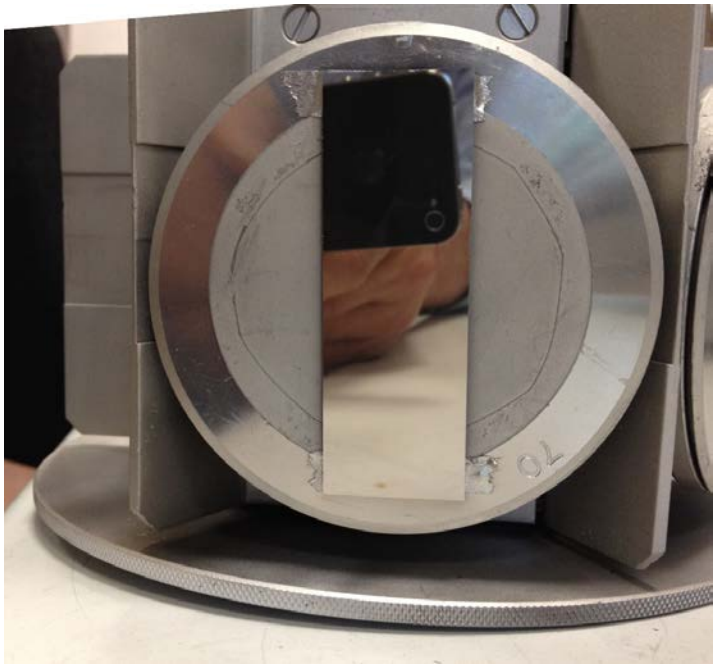

Fig 3 Micro slide after NiCr coating (camera phone is imaged in the coating)

The micro slide was sectioned and imaged in a Hitachi SEM to obtain a reliable estimate of the thickness (SEM image to follow). The measured thickness was 940 ± 5 nm. Note this is more than twice the thickness used by the customer in production, so the temperature recorded by the iButton will be considerably higher than that to be expected in production runs.

The iButton was retrieved and the temperature history readout is shown in Fig 4

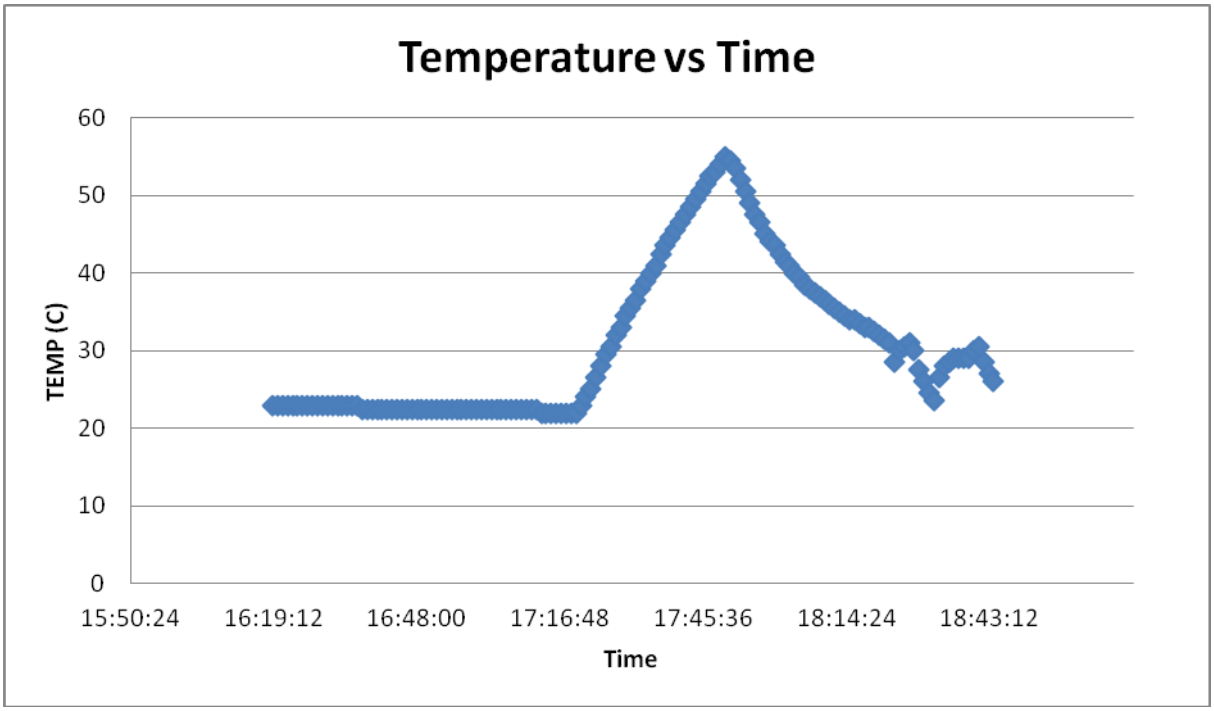

Fig 4 Temperature recorded by iButton sensor during coating run

As can be seen, the deposition started at 17:18 hrs, terminated at 17:48 and the coated samples were retrieved at 18:23 after cooling in the chamber. The maximum temperature reached was only 55 °C after 30 minutes, when the thickness of NiCr coated was 940 nm.

Conclusion

At a calculated deposition rate of 940/1800 nm/s = 0.52 nm/s, the estimated deposition time for a coating of 440 nm thickness would be just over 14 minutes (with current deposition parameters) and the maximum temperature reached by the substrate would be 36.5 °C.

Even allowing for a much higher room temperature than that in our air-conditioned laboratory, there should be no problem in maintaining substrate temperatures of considerably less than 70 °C.

Note: Higher magnetron powers would reduce the coating time but would also increase the temperature. Our current system is limited to powers less than 1000 W so this aspect can not be investigated.

Prof Frank Placido

Thin Film Centre

University of the West of Scotland

Paisley PA1 2BE

Scotland