HARDNESS AND STRUCTURE OF NICKEL ELECTRODEPOSITED FROM ITS CHLORIDE AND ACETATE SALTS DISSOLVED IN PURE DIMETHYLSULFOXIDE

H.K. Srivastava and P.K. Tikoo

Department of Chemistry, Banaras Hindu University, Varanasi 221005 (India)

Earlier studies [1], on the electrodeposition of nickel from nickel chloride or nickel boroflouride dissolved in pure dimethylsulfoxide did not lead to satisfactory results. However nickel acetate/DMSO bath resulted in deposition but conductivity of the bath was too low. Addition of ammonium acetate improved the conductivity of the bath and quality of the deposit [2]. As an extension of this work, deposition was studied with nickel chloride solutions in presence of varying concentration of ammonium acetate.

EXPERIMENTAL

Dimethylsulfoxide was purified as suggested by Le Bel and Goring (3). Copper strips 5x10x1 (mm) were subjected to usual operation of grinding, polishing, degreasing and pickling, before they were used as cathodes. High purity nickel sheets were used as anodes. A copper strip cathode was placed in between two anodes and inter-electrode distance of 20 mm was maintained throughout the experiment. A copper coulometer was employed to measure the quantity of current.

Hardness was measured on a Tukon Wilson microhardness tester using Knoop indenter and a load of 25 g was applied.

The bath composition and the condition of electrolysis are given in Table.

RESULTS AND DISCUSSION

The physical characteristics of nickel electrodeposited from the two media are given in Table 1.

Deposits of nickel obtained from $NiCl_2.6H_2O$/DMSO bath resulted in black and non-adhesive coating unless an optimum concentration of ammonium acetate was added. In presence of 0.4 M ammonium acetate, the deposits obtained were mirror bright if the plating interval was less than fifteen minutes. Ammonium acetate

TABLE 1
NICKEL ELECTRODEPOSITED FROM DMSO BATH
Bath unstirred CD = 0.5 A/dm^2 Temp. 50°

		Acetate Bath	Chloride Bath
Bath	Nickel salt (M)	0.3	0.2
	Boric acid (M)	0.2	0.2
	Am. acetate (M)	0.4	0.4
Characteristics	Nature of 15 min deposition	Bright	Mirror bright
	Cathode efficiency %	70%	40%
	Hardness* 90 min deposition*	250	156

* $(KHN)_{25}$ for Cu basis metal was 68

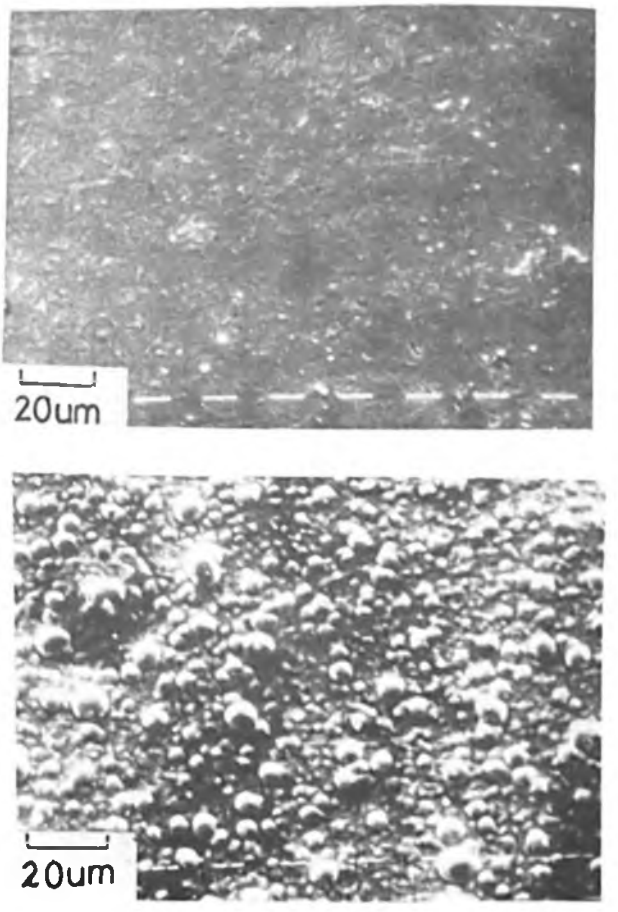


Fig.1 SEM of Ni-surface electrodeposited from DMSO bath (a) Nickel acetate 0.3M; Boric acid 0.2M; Ammonium acetate 0.4M; (b) Nickelchloride·2M; Boric acid 0.2M; Ammonium acetate 0.4M; CD: 0.5 A/dm^2; duration of electrolysis 15 min; temp. 50° C; Magnification, 640X

J. Electrochem. Soc. India.

0013 466 x SN3 (36) 61-62

improved the quality of deposits and conductivity of the bath in case of nickel acetate bath. The reflectivity diminished in both the cases on increasing the plating interval due to reduction of DMSO into IMS (4) and its subsequent adsorption in the cathode deposite. Better buffering capacity of nickel acetate and its enhancement in presence of ammoniun acetate alongwith boric acid [5] resulted in hard deposits (Table 1). Presence of Cl^-, on the other hand softened the deposit [6]. A higher concentration of $Ni(DMSO)_6^{++}$complex [7] in the catholyte in case of nickel acetate bath resulted in high cathode current efficiency and excessive release of DMSO molecules from adions resulted in bulging at the edge and refinement in grain size (Fig.1a) while comparatively a lower concentration of $Ni(DMSO)_6^{++}$complex in case of $NiCl_2.6\ H_2O$/DMSO, CH_3COONH_4 bath led to low cathode current efficiency and less adsorption of DMSO molecules over the surface of nickel deposits resulting in smooth and bright structure (Fig.1b).

ACKNOWLEDGEMENTS

Thanks are due to Professor S.M. Verma, Head, Chemistry Department for providing the necessary facilities. Mr.S.N. Lal of Metallurgical Engineering Department, B.H.U. is thanked for taking SEM pictures. One of us (H.K.S.) gratefully acknowledges the award of teching research fellowship by UGC, Government of India and the grant of academic leave by the management committee of Post-Graduate College, Ghazipur, Uttar Pradesh

REFERENCES

1. S. Biallozor, A. Lisowaka Olaksiak and M. Lieder, *Electrochem. Acta.*, **29** (1984) 233.

2. Communicated to *Journal of Plating and Surface Finishing.*

3. R.G. Le Bel and D.A.I. Goring, *.Chem. Eng. Data*, **7** (1962) 100.

4. M.V. Chankashwili, O.O. Denisova and T.R. Agaladze, *Bull. Acad. Sc.Georgian SSR*, **102** (1981) 365.

5. V. Gluck, *Plat. Surf. Finish.*, **62** (1975) 865.

6. S. Sultan and P.K. Tikoo, *J. Electrochem. Soc. India* **34(1)** (1985) 60.

7. D. Puchalska, E. Kaminska-Piotrowicz and W. Libus, *Electrochem. Acta* **24** (1979) 381.

EXCELL PROCESS PRIVATE LIMITED

Manufacturers: Identification Plates, TV/Radio Decorations, Dials, Advertising Fifts in Multi-Coloured Anodised Aluminium and now in Diamond cut Finish.

Factory & Regd Office	:	117, M.V. Road, Chakala Andheri East, Bombay 400 093.
Phone Nos	:	6323327 8 9
Grams	:	NAMEPLATE Andheri Bombay
Telex	:	011 72208 Excl In