

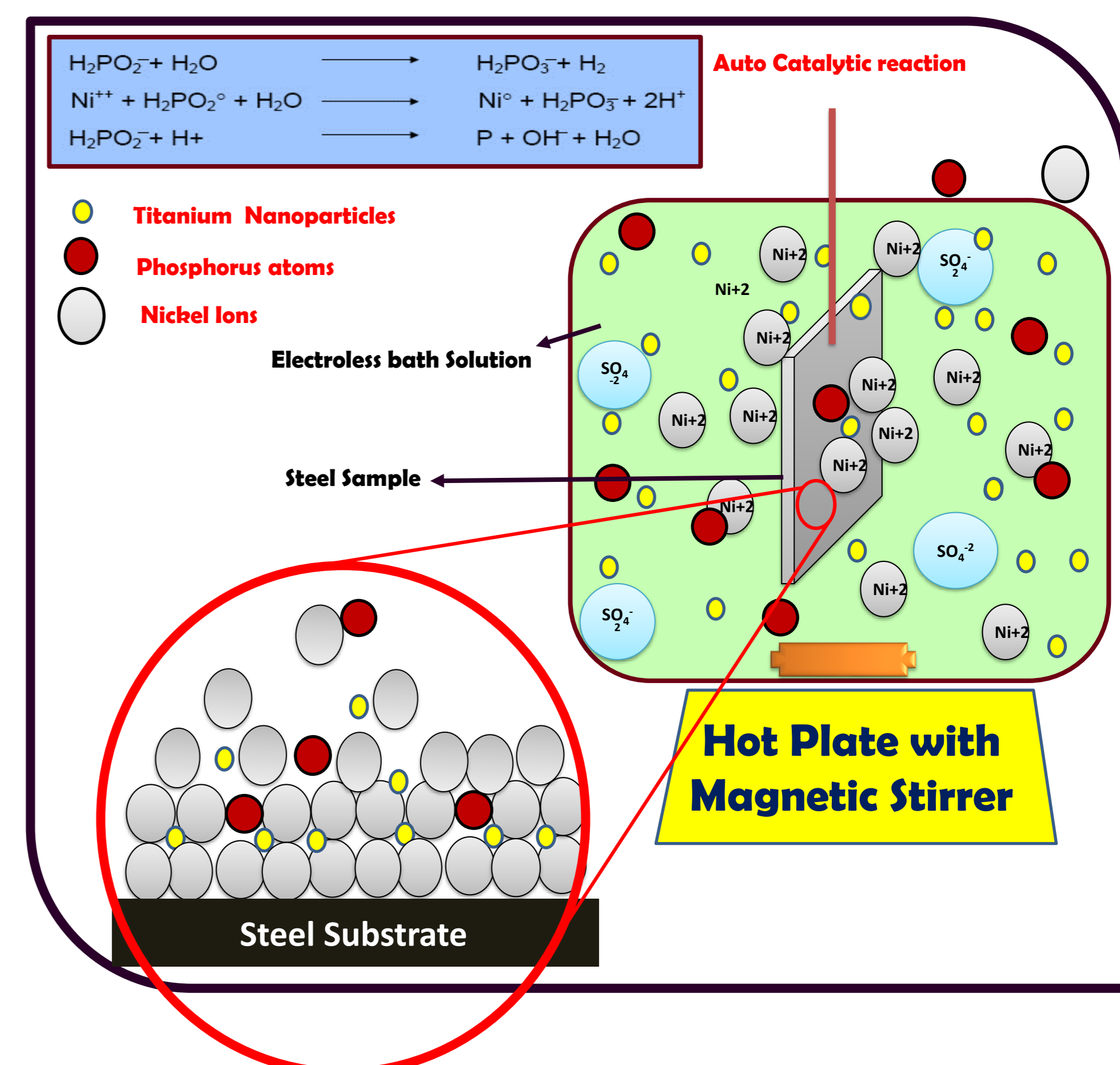
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Abstract

- Nickel Phosphorus (Ni-P) coatings possess tailored mechanical, and anticorrosion properties and have found applications in industries such as automotive, oil and gas, electronics, and aerospace. Their properties can further be enhanced by incorporation of nanoparticles into their (Ni-P) matrix.
- In present study, Ni-P-Ti nanocomposite coatings are developed on High Strength Low Alloy Steel (HSLA) through electroless deposition technique.
- The effect of Ti nanoparticles on structure and mechanical features of Ni-P-Ti coatings are thoroughly studied.

Concept



Methodology

Electroless Bath Composition

Table.1: Coating Bath Composition

Sr. No	Chemical Name	Composition
1	Nickel Sulphate Hexahydrate	34g/L
2	Sodium hypophosphite	35g/L
3	Malic acid	35g/L
4	Succinic acid	10g/L
5	Thiourea	1 ppm
6	Sodium lauryl sulfate	0.2g/L
7	pH	5
8	Temperature	86±2
9	Magnetic stirrer	300rpm
10	Time	90min

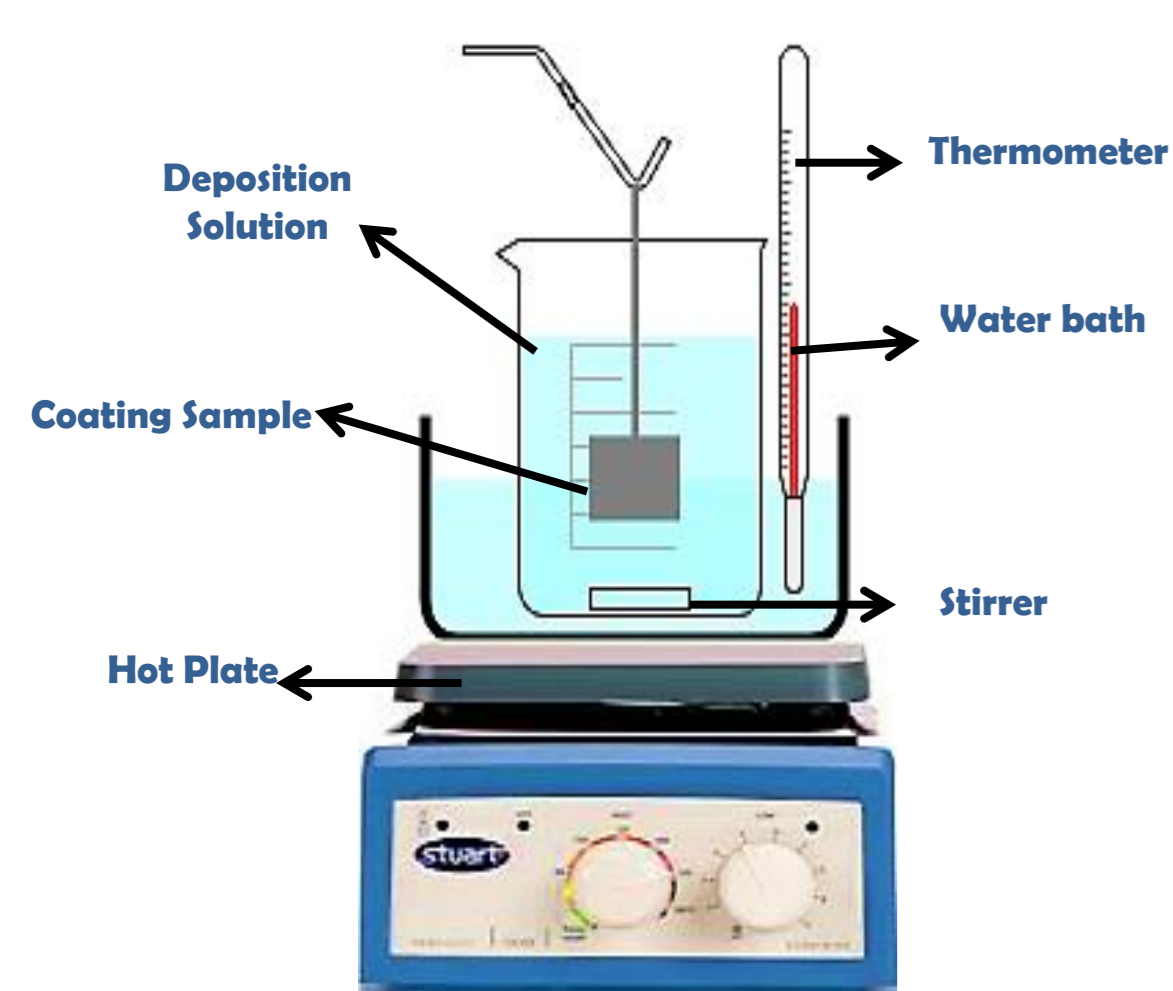


Fig.1. Apparatus and Coatings Deposition Processing

Results

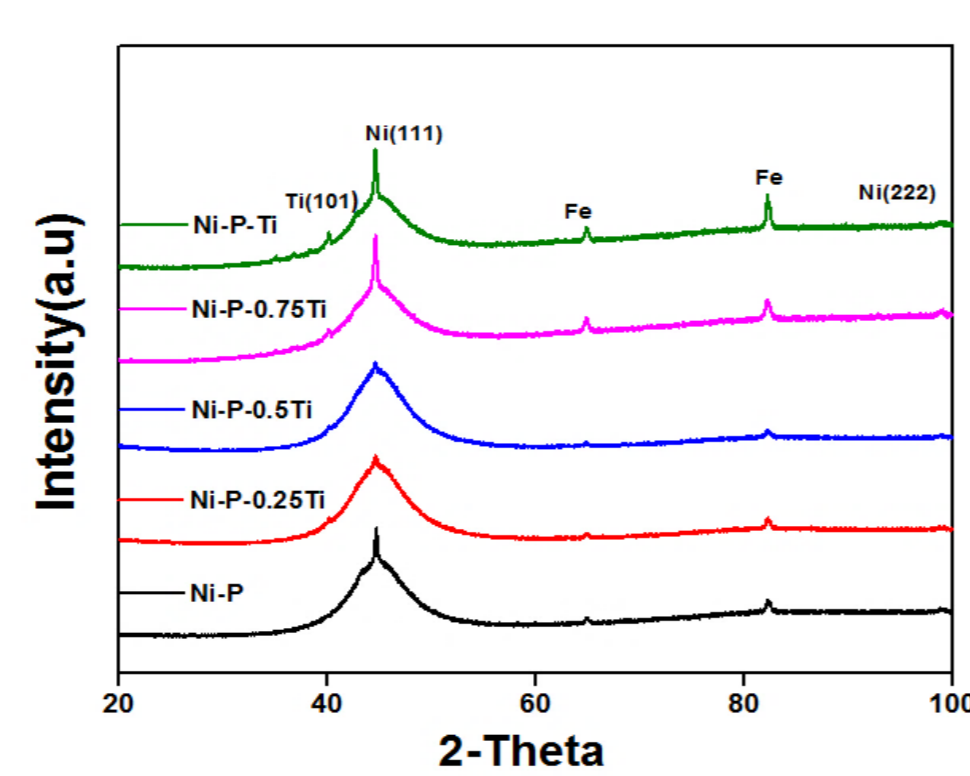


Fig.2. XRD results for coating samples

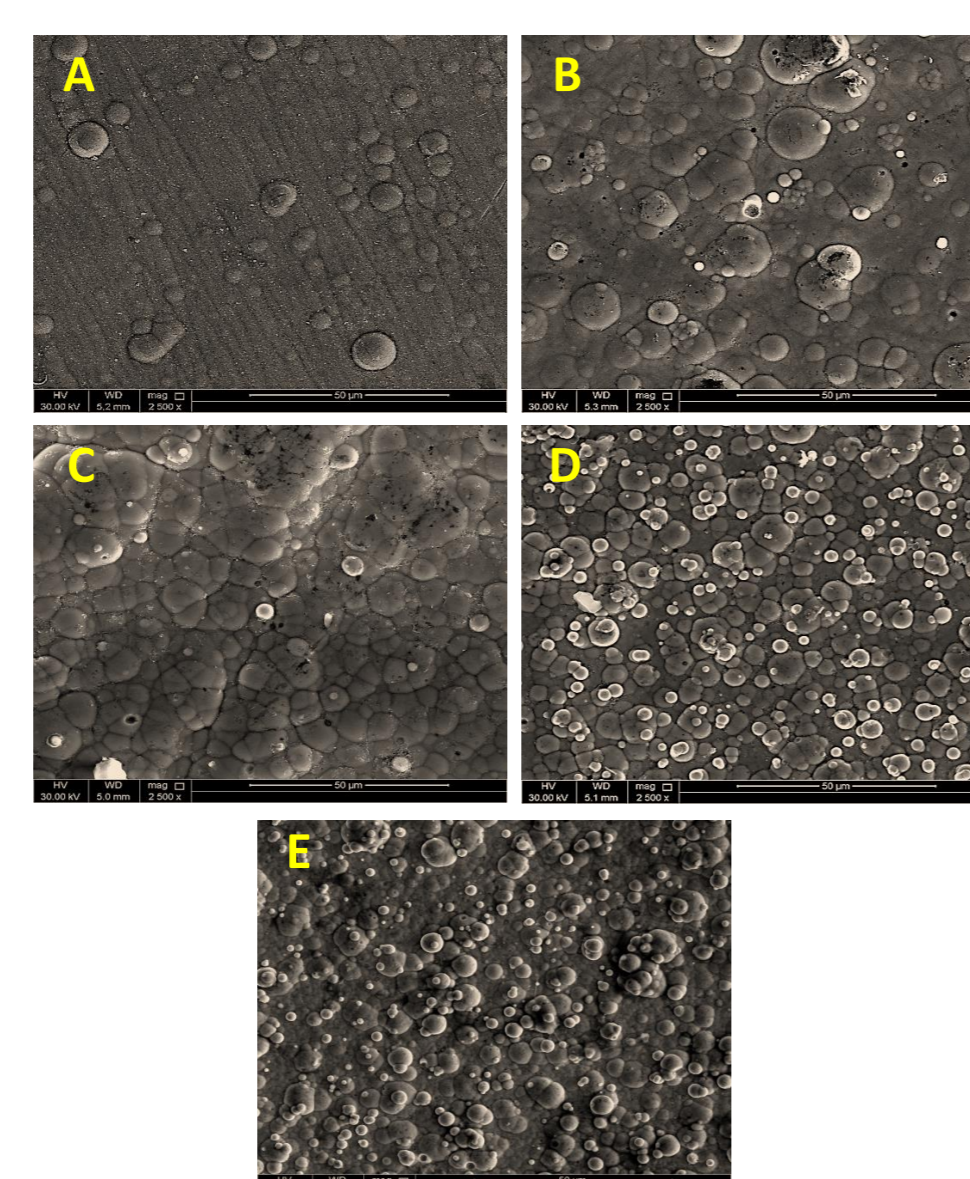


Fig.3. SEM micrographs of Ni-P and Ni-P-Ti coating samples (Ti concentration as :- A- 0.0g/L, B- 0.25g/L, C-0.5 g/L, D- 0.75g/L, E- 1.0g/L)

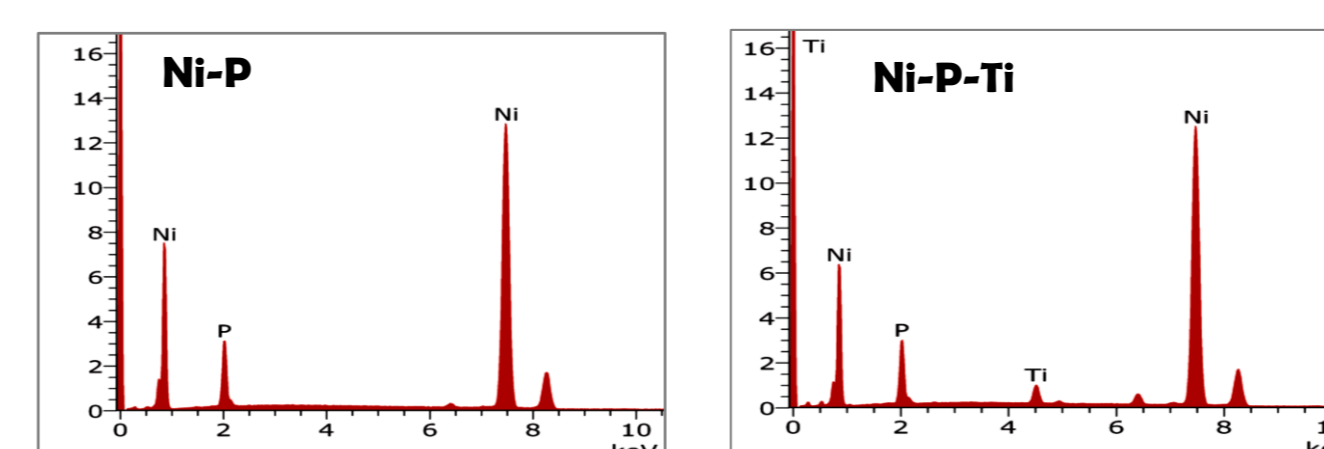


Fig.3 EDX Results

Table.1: Composition Analysis by EDX

%Composition	Ni-P	Ni-P-0.25Ti	Ni-P-0.5Ti	Ni-P-0.75Ti	Ni-P-Ti
Ni	89.15	88.8	88.05	86.96	86.48
P	10.85	10.6	10.3	10.22	10.18
Ti	0	0.6	1.65	2.81	3.28

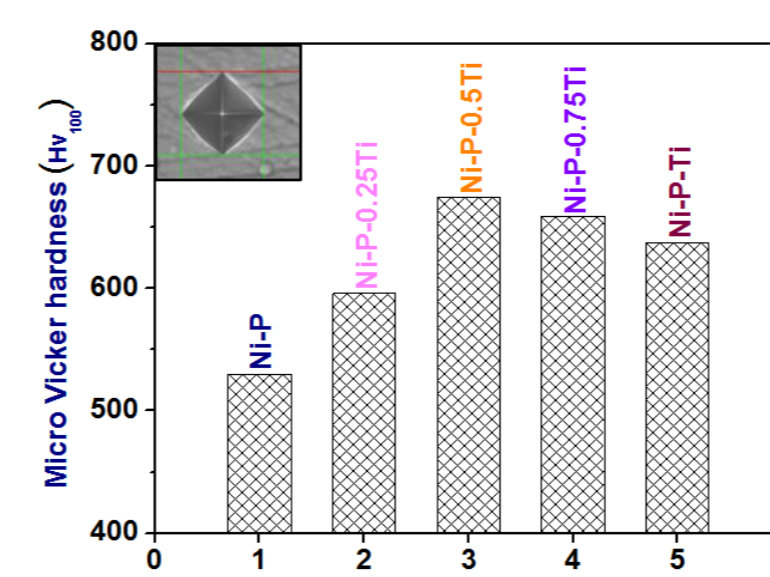


Fig.4 Vickers Hardness test results

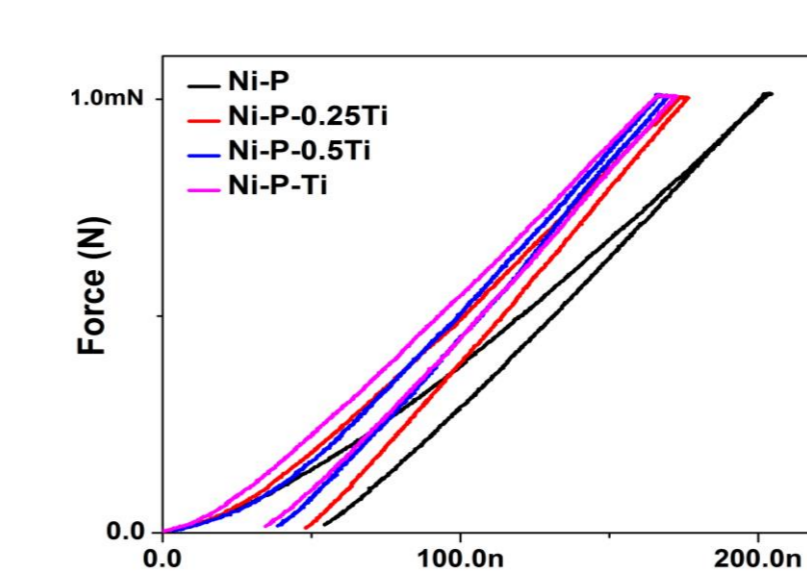


Fig.5 Nano Indentation graph

Table.2 Nano indentation results

Parameter	Measured values				
Modulus(E), GPa	12.88	16.21	18.26	17.15	17.48
Stiffness, kN/m	7.52	8.5	9.02	8.18	8.22
Hardness, GPa	4.86	5.5	5.92	6.27	6.41
Composition	Ni-P	Ni-P-0.25Ti	Ni-P-0.5Ti	Ni-P-0.75Ti	Ni-P-1.0Ti

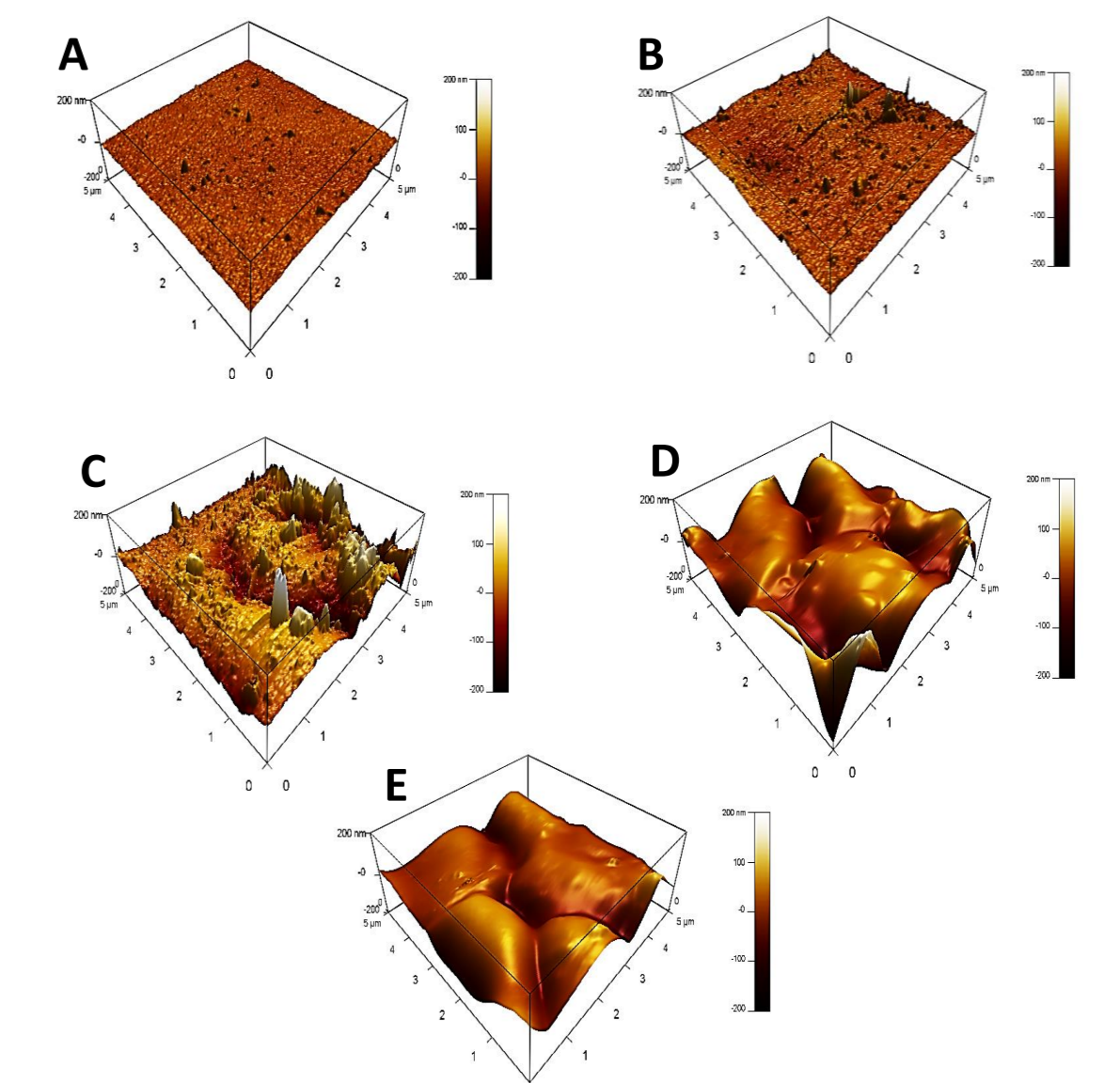


Fig.6. AFM 3D images of Ni-P and Ni-P-Ti coating samples (Ti concentration as :- A- 0.0g/L, B- 0.25g/L, C-0.5 g/L, D- 0.75g/L, E- 1.0g/L)

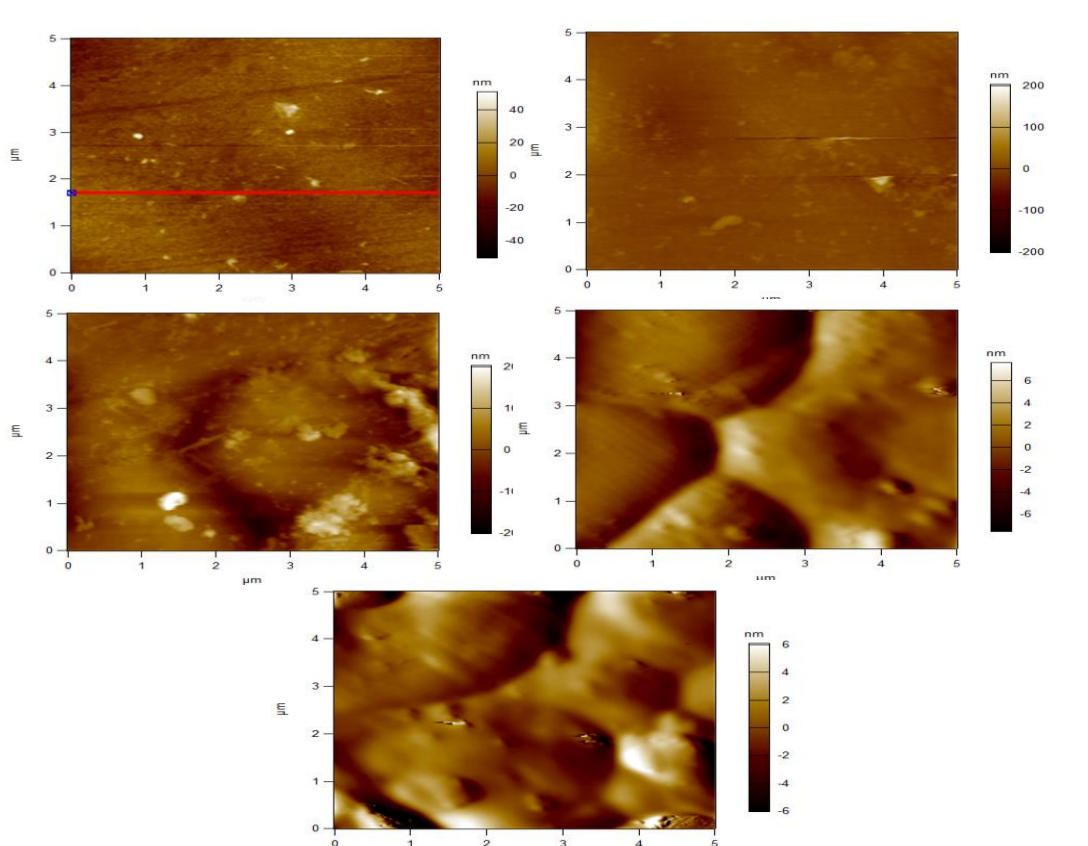


Fig.7 AFM 2D images

Applications



Conclusions

- Ni-P and Ni-P-Ti nanocomposite coatings (with varying Nanoparticles concentration) are successfully deposited on a HSLA steel substrate.
- Composite Coatings presenting a homogeneous and dense structure with an adequate adhesion to the substrate.
- Nanoparticles efficiently influence on microstructure and mechanical properties of composite coating materials.
- Highest properties and surface characteristics are exhibited by Ni-P-0.5Ti.