

Seminar Title	: Fabrication of Mo-based alloys by pressureless and spark plasma sintering
Speaker	: Sambit Swain (Rollno : 522mm1004)
Supervisor	: Anshuman Patra
Venue	: M.Tech. Classroom (Annex Building MM Department)
Date and Time	: 10 Mar 2025 (4:15 PM)
Abstract	: In this study, six distinct alloy compositions were synthesized via mechanical alloying as S1 ($\text{Mo}_{80}\text{Ni}_{10}\text{Si}_{10}$), S2 ($\text{Mo}_{80}\text{Ni}_{10}\text{Co}_{10}$), S3 ($\text{Mo}_{80}\text{Ni}_{10}\text{Si}_5\text{Co}_5$), S4 ($\text{Mo}_{79}\text{Ni}_{10}\text{Si}_{10}(\text{Y}_2\text{O}_3)_1$), S5 ($\text{Mo}_{79}\text{Ni}_{10}\text{Co}_{10}(\text{Y}_2\text{O}_3)_1$), and S6 ($\text{Mo}_{79}\text{Ni}_{10}\text{Si}_5\text{Co}_5(\text{Y}_2\text{O}_3)_1$) (in weight%) followed by conventional sintering at 1500 °C for 1.5 h in continuous flowing hydrogen atmosphere. The spark plasma sintering (SPS) was done at 1150 °C for 5 min at 60 MPa pressure. After 20 h of milling, few oxide particles were encapsulated within Mo particles and others were dispersed at Mo matrix boundary. Alloy S4 containing Y_2O_3 exhibited the smallest particle size (0.51 μm) and a bimodal particle size distribution. XRD analysis of H_2 sintered samples identifies the presence of hard and brittle intermetallic phases, including Mo_3Si (cubic), Ni_2Si (orthorhombic), and MoNi (orthorhombic). SEM analysis reveals that Y_2O_3 nanoparticles reduce the average grain size of the Mo matrix. Elemental mapping confirms the presence of Y_2O_3 within the Mo matrix in alloys S4 to S6. Among H_2 sintered alloys, S6 achieves the highest relative density of 93.04%. Alloy S2 exhibited the highest hardness values of 9.08 GPa and minimum specific wear rate of $0.13 \times 10^3 \text{ mm}^3/\text{N.m}$, attributed to its significant intermetallic phase formation. Incorporating Y_2O_3 particle improve the wear resistance of Mo alloys due to oxide dispersion strengthening. The high-temperature oxidation study at 1000 °C at 10 h of H_2 sintered samples illustrates minimum weight change and maximum oxidation resistance in the S6 sample, which is attributed to its lowest porosity. Among all the alloys investigated, SPSed alloy S1 exhibited the highest hardness (25.08 GPa), whereas SPSed alloy S6 achieved the highest sintered density (99.54%) and superior wear resistance (specific wear rate: $0.31 \times 10^{-4} \text{ mm}^3/\text{N.m}$). The rapid SPS cycle effectively suppressed grain growth, significantly enhancing strength and hardness compared to conventionally sintered Mo alloys.