Course code Course title



METRO 001 Solidification of metals

## **Course summary**

The course gives an introduction to microstructure formation during solidification of metals. Nucleation and growth of crystals form the melt is treated and the morphology of different microstructural features such as cells and dendrites is described. Three phase reactions such as eutectic and peritectic solidification is treated. Redistribution of solute during solidification of alloys is described. Finally, some experimental techniques for studying solidification are described.

## Lectures list

IntroductionBasicconcepts, heatflow, solidificationArnberg, Lars44'1IntroductionBasicconcepts, capillaryeffects, soluteLars44'2.grain refinementand heterogeneous nucleation, nucleation rate, grainArnberg, Lars35'2.grain refinementInterface structure, facetted & non-facetted growth, Arnberg, (atomic scale)Arnberg, anisotropy, modification of growth mechanisms34'3.morphology (atomic scale)Solutepile-upatsolid-liquidinterface.4.stability, constitutional undercoolingConstitutional undercooling. Interface instability of alloysArnberg, Lars32'5.Cells endritesand Morphology and crystallography of cells and dendrites. Supersaturation and growth undercooling. Primary and secondary arm spacingArnberg, Lars31'6.peritectic solidificationMass equilibrium, and non-equilibrium conditions. Freezing point. MicrosogregationArnberg, Lars33'7.Segregation equilibrium, and non-equilibrium conditions. Freezing point. MicrosogregationArnberg, Lars33'8.Experimental techniques for studying solidificationMicroscopy of solidified microstructures. Arnberg, Lars39'	n.	Title	Summary	Lecturer	Duration
1       microstructures, capillary effects, solute Lars         2.       redistribution         2.       grain refinement and heterogeneous nucleation, nucleation rate, grain refinement         3.       Crystal         3.       Interface structure, facetted & non-facetted growth, Arnberg, (atomic scale)         4.       Stability, constitutional undercooling. Interface instability of alloys         5.       Cells         6.       peritectic solidification         7.       Segregation         7.       Segregation         8.       Experimental Microscopy of solidified microstructures. Freezing point. Microscopy of solidified microstructures. Arnberg, tury, and non-equilibrium conditions. Freezing point. Microscopy of solidified microstructures. Arnberg, tury imaging, Thermal analysis		Introduction	Basic concepts, heat flow, solidification	Arnberg,	44'
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3.       morphology (atomic scale)       anisotropy, modification of growth mechanisms       Lars         4.       Interface stability, constitutional undercooling       Solute pile-up at solid-liquid interface. Constitutional undercooling. Interface instability of alloys       Arnberg, Lars       32'         5.       Cells dendrites       and dendrites. Supersaturation and growth undercooling. Primary and secondary arm spacing       Arnberg, Lars       31'         6.       peritectic solidification       Regular & irregular eutectics. Diffusion-coupled growth. Capillary effects. Peritectic growth       Arnberg, Lars       36'         7.       Segregation       Mass balance, solute redistribution during equilibrium, and non-equilibrium conditions. Freezing point. Microsegregation       Arnberg, Lars       33'         8.       Experimental techniques for studying solidification       Microscopy of solidified microstructures. Solidification       Arnberg, Lars       39'		Crystal	Interface structure, facetted & non-facetted growth,	Arnberg,	34'
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<ul> <li>4. stability, constitutional undercooling. Interface instability of Lars alloys</li> <li>4. stability, constitutional undercooling. Interface instability of Lars alloys</li> <li>5. Cells and Morphology and crystallography of cells and Arnberg, dendrites. Supersaturation and growth undercooling. Lars</li> <li>5. Eutectic and Regular &amp; irregular eutectics. Diffusion-coupled Arnberg, primary and secondary arm spacing</li> <li>6. Eutectic and peritectic growth. Capillary effects. Peritectic growth</li> <li>7. Segregation</li> <li>8. Experimental techniques for studying solidification</li> <li>8. Experimental techniques for studying solidification</li> <li>9. Experimental techniques for st</li></ul>		Interface	Solute pile-up at solid-liquid interface.	Arnberg,	32'
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6.       peritectic solidification       growth. Capillary effects. Peritectic growth       Lars         7.       Segregation       Mass balance, solute redistribution during equilibrium, and non-equilibrium conditions. Freezing point. Microsegregation       Arnberg, Lars       33'         8.       Experimental techniques for studying solidification       Microscopy of solidified microstructures. imaging, Thermal analysis       Arnberg, Lars       39'		Eutectic and	Regular & irregular eutectics. Diffusion-coupled	Arnberg,	36'
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solidification		studying	imaging, Thermal analysis		
		solidification			41. 473

## Lectures prerequisites chart



Each arrow means a prerequisite.