Fiscal Year:	FY 2018	**Task Last Updated:**	FY 10/25/2018
PI Name:	Ankit, Kumar Ph.D.		
Project Title:	Advanced Modeling and Simulation of Crystal Growth Dynamics		
Division Name:	Physical Sciences		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:	MATERIALS SCIENCE--Materials science		
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	None		
Human Research Program Risks:	None		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
PI Email:	kumar.ankit@asu.edu	**Fax:**	FY
PI Organization Type:	UNIVERSITY	**Phone:**	480-965-4541
Organization Name:	Arizona State University		
PI Address 1:	School for Engineering of Matter, Transport and Energy		
PI Address 2:	551 E Tyler Mall, ERC 265		
PI Web Page:			
City:	Tempe	**State:**	AZ
Zip Code:	85287	**Congressional District:**	9
Comments:			
Project Type:	GROUND,Physical Sciences Informatics (PSI)	**Solicitation / Funding Source:**	2017 Physical Sciences NNH17ZTT001N-17PSI-D: Use of the NASA Physical Sciences Informatics System – Appendix D
Start Date:	08/01/2018	**End Date:**	07/31/2019
No. of Post Docs:		**No. of PhD Degrees:**	
No. of PhD Candidates:		**No. of Master' Degrees:**	
No. of Master's Candidates:		**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:		**Monitoring Center:**	NASA MSFC
Contact Monitor:	Su, Ching-Hua	**Contact Phone:**	256-544-7776
Contact Email:	ching.h.su@nasa.gov		
Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Glicksman, Martin Ph.D. (Florida Institute of Technology)		
Grant/Contract No.:	80NSSC18K1440		
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Task Description:	Our recent theoretical analyses of the Isothermal Dendritic Growth Experiment (IDGE) archived in the NASA Physical Sciences Informatics (PSI) System reveals the presence of a 4th-order interfacial scalar field, termed the bias field, which works in the background and dynamically couples with interface normal motion. Solid-liquid interfaces support such scalar perturbation fields by adding or withdrawing small amounts of thermal energy. Preliminary insights suggest that perturbation fields modulate interface motion and can stimulate pattern formation depending upon the interface's curvature distribution. However, our current understanding of the factors that govern the intensity of capillary-mediated fields is limited to pure melts and to two spatial dimensions. Moreover, any quantitative understanding of the intensity threshold beyond which such capillary-mediated fields can potentially modulate pattern formation is all together, absent. Surface curvature and crystal-melt anisotropy strongly influence bias fields. Motivated by our recent detection of perturbation fields on Grain Boundary Grooves (GBGs), which also appear to explain the anomaly reported in the USMP-4 data, the underlying hypotheses that we intend to test are: (a) weak capillary fields that are resident on solid-liquid interfaces, modulate the shapes of melting crystalline fragments, and (b) shape perturbations from capillary fields amplify on unstable interfaces and instigate instabilities on interfacial regions of equilibrated GBGs. Our 3D phase-field simulations on grooving will provide unprecedented insights into this fascinating autogenous mechanism of pattern formation and might also enable us to develop novel processing methods to improve microstructure-level control in alloy castings. The associated issue of comparing the efficacy of noise amplitude to the bias field intensity--fundamental issue in understanding pattern formation-- will also be investigated theoretically and via the phase-field techniques.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	
Task Progress:	New project for FY2018.
Bibliography Type:	Description: (Last Updated: 11/17/2022)