IGEM Grant Report

☒ Progress (due January 1) ☐ Annual (due July 31) ☐ Final (due August 31)

IGEM Grant # IGEM 25-005 Principal Investigator Krishnan S Raja

Name/Full Title of Project: Self-healing Composites for Aggressive Environments

Submission Date 12/31/2025 Primary Institution University of Idaho

Section 1: Project and its goals
The overall goal is to develop self-healing composite materials based on metal-matrix – metal-core oxide shell (MCOS) nanocapsules distributed in metal and ceramic matrices to enhance the lifetime of components used in the power generation industry.

Section 2: Project accomplishments for the reporting period and future plans
Accomplishments: 1. Successful preparation of different MCOS materials such as Sn-SnO_2, Zn-ZnO, and Bi-$Bi2O_3$; 2. Preparation of Sn-MCOS-SnO_2 and Zn-MCOS-ZnO ceramic matrix composite rectangular prism samples for 3-point bend testing; 3. Microstructural characterization of the samples, and 4. Modified jig design and fabrication for 3-point bend testing to show self-healing behavior
Future Plans: 1. Achieving > 95% theoretical density of the ceramic matrix samples; and 2. Long-term 3-point-bend tests at high temperatures to demonstrate self-healing behavior unequivocally.

Section 3: Summary of budget expenditures
Personnel costs (salary and fringe): 96.7% of the budgeted amount is spent. The expenditure is on track with the balance of funds to be used for stipends for graduate and undergraduate students.
Operating expenses: 96.17% of the budgeted amount is spent.
Student tuition/health insurance: 100% of the budgeted amount is spent.
Overall, the project expenditure is consistent with the anticipated spending.

Section 4: Economic development/impact
One STTR phase 1 grant was awarded in collaboration with a Nevada based company. One research grant pre-proposal is under preparation to be submitted to NEUP-DOE funding cycle of 2026, which is due on January 28, 2026.

Section 5: Faculty and student participants.
1. Krishnan S Raja, PI, faculty: Overall project direction; 2. Indrajit Charit, co-PI, faculty: Supervision and guidance of research effort; 3. Kavindan Balakrishnan, graduate student (MCOS-Metal matrix composite), and 4. Jonah Hudman, graduate student (MCOS-Ceramic matrix composite).

Section 6: Long-term sustainability plan
A LDRD proposal was submitted last year but was not funded. We want to update the proposal based on the review comments and resubmit. We are submitting a pre-proposal to DOE-NEUP as indicated in Section 4.

Section 7: Expenditure Report (attached below)

	Budgeted, $	Spent, $	Balance, $	% Remaining
Salary	109,077.16	106,169.31	2,907.85	3.7
Fringe	9,114.60	9,311.82	-197.22	
Materials & Supplies	40,793.24	39,230.76	1,562.48	3.83
Tuition	38,615.00	38,615.00	0	
Total	197,600.00	193326.00	4,273.11	2.16