Deep Learning for Predicting the Thermomechanical Behavior of Shape Memory Polymers

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Award Title:	RII Track 1: Louisiana Materials Design Alliance (LAMDA)
NSF Award Number:	NSF OIA-1946231
Program Director:	Michael Khonsari
Lead Institution Name:	Name of Institution of Submitting the Highlight
Award Start Date:	July 1, 2020
Award End Date:	June 30, 2025
Highlight Submission Date:	February 28, 2024

What is the outcome or accomplishment? (1-2 short sentences describing it and why it is transformative; 50-word maximum suggested)*

A deep learning scheme was developed to predict the behavior of shape memory effect (SME) of shape memory polymers (SMPs). Validating the results using data from different SMPs reveals the versatility of the scheme. Figure 1 displays the prediction results for two SMP datasets with stress and stress-free conditions, respectively.

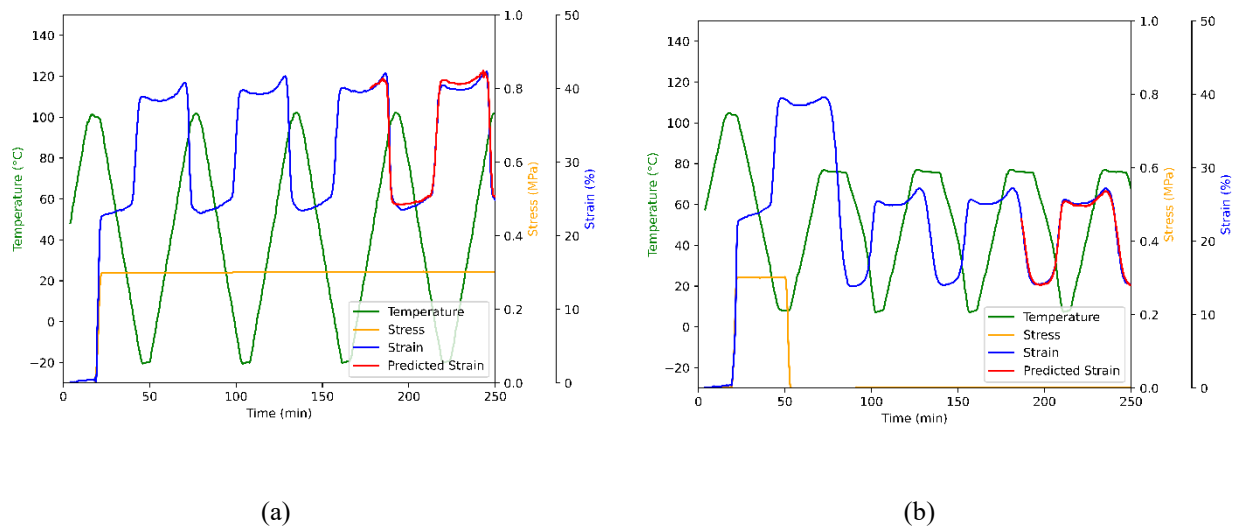(a)   (b)

Figure 1: Prediction result using the deep learning scheme for the shape memory effect (a) under stress and (b) stress-free condition.

What is the impact? (1-2 simple sentences describing the benefits for science, industry, society, the economy, national security, *etc.*; suggested 50-word maximum)

Implementation of the proposed deep learning scheme saves the time and resources needed to test and discover shape memory polymers utilizing the proposed deep learning scheme.

What explanation/background does the lay reader need to understand the significance of this outcome? (1-2 paragraphs that might include, for example, more on who, when, where; NSF's role; support from multiple directorates/offices; what makes this accomplishment unique; additional intellectual merits; or broader impacts such as education, outreach, or infrastructure improvement that are integral to this outcome; suggested 150-word maximum)

LAMDA's team led by Dr. Jinyuan Chen at Louisiana Tech University developed a deep learning scheme for characterizing the behavior of shape memory polymers in 2023. This approach is well suited for accelerating the evaluation and development of new shape memory polymers. It is also beneficial to test the deep learning scheme using data from various shape memory polymers to estimate the versatility of the scheme. This research has provided insights to students and practitioners who are interested in materials science and how machine learning can be applied to this area.