Plan Overview

A Data Management Plan created using DMPTool-Stage

Title: CAREER: 4.5D Printing of Nickel Titanium Shape Memory Alloys

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CAREER: 4.5D Printing of Nickel Titanium Shape Memory Alloys

Roles and responsibilities

The Data Management Plan should outline the rights and obligations of all parties as to their roles and responsibilities in the management and retention of research data. It must also consider changes to roles and responsibilities that will occur should a principal investigator or co-PI leave the institution.

As the sole PI on the project, . Alaa Elwany, will take the lead and responsibility for coordinating and assuring data storage and access. He will coordinate between his graduate students and his on-campus and off-campus collaborators, and will adhere to the Texas A&M University Standard Administrative Procedure (SAP) on the Responsible Stewardship of Research Data (http://rules-saps.tamu.edu/PDFs/15.99.03.M1.03.pdf)

Expected data

The Data Management Plan should describe the types of data, samples, physical collections, software, curriculum materials, and other materials to be produced in the course of the project. It should then describe the expected types of data to be retained.

This project will generate data resulting from:

(1) **Experimental testing and characterization** of samples and test coupons made of nickel-titanium shape memory alloys manufactured using laser powder bed fusion additive manufacturing. The data include transformation temperatures obtained using differential scanning calorimetry and images of microstructures obtained using scanning electron microscopy (SEM) and transmission electron microscopy (TEM).

(2) **Simulation data** from a finite elements thermal model implemented in COMSOL multiphysics and a precipitates evolution physics-based model implemented in MatCalc. Both models are developed by the PI. The simulations will be primarily run on Texas A&M HPC facility.

Period of data retention

The Data Management Plan should describe the period of data retention. Minimum data retention of research data is three years after conclusion of the award or three years after public release, whichever is later. Public release of data should be at the earliest reasonable time. A reasonable standard of timeliness is to make the data accessible immediately after publication, where submission for publication is also expected to be timely. Exceptions requiring longer retention periods may occur when data supports patents, when questions arise from inquiries or investigations with respect to research, or when a student is involved, requiring data to be retained a timely period after the degree is awarded. Research data that support patents should be retained for the entire term of the patent. Longer retention periods may also be necessary when data represents a large collection that is widely useful to the research community. For

example, special circumstances arise from the collection and analysis of large, longitudinal data sets that may require retention for more than three years. Project data-retention and data-sharing policies should account for these needs.

The data will be preserved by the PI for at least three years beyond the award period, as required by NSF guidelines. In addition, publicly available portions of the data will be curated in the Texas Data Repository (https://tdl.org/data-repository/) through the Texas Digital Library (TDL). Data curated in the Texas Data Repository will be preserved through the Digital Preservation Network. TDL accepts the responsibility to preserve and provide access to research data, including associated metadata and documentation that is properly deposited in the Texas Data Repository. This responsibility includes the provision of digital means to preserve and ensure ongoing access to said content for a minimum period of ten years after it is deposited.

Data formats and metadata

The Data Management Plan should describe the specific data formats, media, including any metadata.

Experimental data will primarily consist of (1) excel spreadsheets and (2) micrographs. Data will be made available in the literature through publications.

Excel preadsheets, or other proprietary formats, will be converted to CSV non-proprietary format. Micrographs are image files that will be stored in standard ".bmp" and ".jpg" formats. In addition to the raw data, uncorrected sensor data, converted and corrected data (in engineering units), as well as several other forms of derived data will be produced. Metadata that describes the experiments include raw materials used, process variables, and parameters emlpoyed during the experiments.

Simulation data will primarily consist of computational representations of the spatial and temporal evolution of temperature and second phase precipitates. The simulations will be obtained through the numerical solution of finite element models (implemented in COMSOL Multiphysics) and a Numerical Kampmann-Wagner (NKW) framework (implemented in Matcalc). Simulation datasets will also be accompanied by metadata that will include information about the simulation design points.

The generated simulation data will be stored as ASCII or binary computer data files that can be viewed and/or post-processed via standard open-source and commercial codes including, MATLAB™. These computer files will be accompanied by dated laboratory notebooks, which will be digitized or captured electronically. Data and digtized notes will be organized by date, experiment type, and experiment number.

Data dissemination and policies for public access, sharing and publication delays

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The Data Management Plan should clearly articulate how "sharing of primary data" is to be implemented. It should describe dissemination approaches that will be used to make data available to others.Policies for public access and sharing should be described, including provisions for appropriate protection of privacy, confidentiality, security, intellectual property, or other rights or requirements. Research centers and major partnerships with industry or other user communities must also address how data are to be shared and managed with partners, center members, and other major stakeholders.

Publication delay policies (if applicable) must be clearly stated. Investigators are expected to submit significant findings for publication quickly that are consistent with the publication delay obligations of key partners, such as industrial members of a research center.

Analyzed Data resulting from our analysis of raw data will be used to generate charts, figures, and tables that will be used in conference presentations and journal publications.

Data Not Used towards Publication Our quantitative data is likely to be valuable for the manufacturing community. Consequently, raw data that is not used towards publication will still be screened for quality, though it will be tagged as unpublished.

The PI will be willing to share raw and analyzed data that has been used towards publication, upon request. He would expect that upon completing their independent data analysis, researchers would cite our published work and/or provide coauthorship as necessary.

To ensure that the data will be discoverable by the larger research community, it will be curated in the Texas Data Repository (https://tdl.org/data-repository/) through the Texas Digital Library. The Texas Data Repository uses the Creative Commons CC0 option as its default license.

Data storage and preservation of access

The DMP should describe physical and cyber resources and facilities that will be used for the effective preservation and storage of research data. In collaborative proposals or proposals involving sub-awards, the lead PI is responsible for assuring data storage and access.

The electronic data will be stored in multiple backups, including optical media and hard drive storage. Synchronous backup systems performing daily incremental backups and scheduled archival backups will store data on multiple, spatially diverse resources, including cloud-based, off-site storage services.

Librarians in the Office of Scholarly Communications in the Texas A&M University Libraries will guide and support the principle investigators in data curation within the Texas Data Repository (TDR), including identification of appropriate metadata, data formats, and data annotation that supports reuse. The Texas Digital Library (TDL) will have responsibility for maintenance of the TDR as well as data preservation, as detailed in the Period of Data Retention Section.