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Author Names & Affiliations

Submitting author: Pupa Gilbert - University of Wisconsin - Madison

Additional authors: None

Contact Email Address (for NSF use only): (hidden)

Research domain(s), discipline(s)/sub-discipline(s)

Biom mineralization; biomaterials; synchrotron spectromicroscopy;

Title of Response

Spectromicroscopy of biominerals and biomaterials: structure and formation mechanisms

Abstract

Biomineral and biomaterial structure and formation mechanisms using can be discovered using synchrotron spectromicroscopies in 2D and 3D, revealing structure, chemical composition, and crystal orientation, with nanometer-micrometer resolutions. Storage, retrieval, transfer, and processing of

synchrotron spectromicroscopy data represents a huge challenge, that should be addressed in the near future.

Question 1 (maximum 400 words) – Data-Intensive Research Question(s) and Challenge(s). Describe current or emerging data-intensive/data-driven S&E research challenge(s), providing context in terms of recent research activities and standing questions in the field. NSF is particularly interested in cross-disciplinary challenges that will drive requirements for cross-disciplinary and disciplinary-agnostic data-related CI.

Synchrotron spectromicroscopies in 2D and 3D generate an immense amount of data, to be analyzed for structure, chemical composition, and crystal orientation, with nanometer-micrometer resolutions. This represents a huge challenge for data storage, retrieval, transfer, and processing. Machine learning can and will help the latter, but not the formers.

Question 2 (maximum 600 words) – Data-Oriented CI Needed to Address the Research Question(s) and Challenge(s). Considering the end-to-end scientific data-to-discovery (workflow) challenges, describe any limitations or absence of existing data-related CI capabilities and services, and/or specific technical and capacity advancements needed in data-related and other CI (e.g., advanced computing, data services, software infrastructure, applications, networking, cybersecurity) that must be addressed to accomplish the research question(s) and challenge(s) identified in Question 1. If possible, please also consider the required end-to-end structural, functional and performance characteristics for such CI services and capabilities. For instance, how can they respond to high levels of data heterogeneity, data integration and interoperability? To what degree can/should they be cross-disciplinary and domain-agnostic? What is required to promote ease of data discovery, publishing and access and delivery?

all of the above are challenges: advanced computing, data services, software infrastructure, applications, networking, cybersecurity

Question 3 (maximum 300 words) – Other considerations. Please discuss any other relevant aspects, such as organization, processes, learning and workforce development, access and sustainability, that need to be addressed; or any other issues more generally that NSF should consider.

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