Cover page (1 page)

Research Development Fund – 2020-2021 Application Template
SUBMISSION DEADLINE: EXTENDED to *Monday – October 26, 2020 at 12 noon CDT* to rdf@tamu.edu

Applications that exceed page limits for any section or do not follow template will not be reviewed*

Application Title: The Acquisition of an Ambient Pressure X-ray Photoelectron Spectroscopy System for *in situ* Studies of Interfacial Processes in Materials

Lead contact for RDF Application:
Name: James D. Batteas
Department: CHEM, MSEN
Email address: batteas@tamu.edu
Phone number: 979-458-2965

Co-Leads: Sarbajit Banerjee (CHEM/MSEN), Ali Erdemir (MEEN), Melissa Grunlan (BMEN); Miladin Radovic (MSEN), Virender Sharma (SPH)
Key Participating Units: COS, COE, HSC

Anticipated Request Amount ($): $1,529,464

Executive summary of this application to utilize Research Development Funds. This proposal is aimed at addressing core needs for enhancing *in situ* materials (including biological interfaces) analysis tools for nanoscience and nanotechnology at TAMU. Recent investments have significantly advanced our electron microscopy capabilities on campus however, key missing elements to our materials analysis suite include *in situ* tools for examining the local chemical changes on the nanoscale in materials (especially at interfaces) while they undergo associated mechanical, electrical or other environmental stresses. X-ray photoelectron spectroscopy (XPS) is a uniquely surface sensitive technique that due to the short mean-free path of electrons in solids, permits the exquisite analysis of interfacial chemistry of the outermost 1-10 nm of materials. Importantly, XPS allows for element specific identification, as well as affords sensitivity to local chemical environment (i.e. oxidation state) providing key details to both the spatial distribution of elements in the near surface revision of materials. While normally such measurements can only be taken under high vacuum conditions, recent advances now make it possible to follow such surface chemical changes in situ, and it is here that we seek to advance our suite of tools to afford this unique capability to the TAMU community.

Thus, we are seeking to add an environmental XPS system to provide the ability to examine on the nano/atomic scale simultaneous chemical changes in materials under and range of environmental conditions, and in some cases *in operando* (e.g. during the application of mechanical and electrical forces). These types of measurements are key to addressing new materials design in numerous areas from batteries, to biological and environmental interfaces, to engines, to quantum electronics. At TAMU we have significant research expertise in these areas, and the acquisition of these tools will elevate the researchers at TAMU to the top level. Such capabilities are currently ONLY available in the US at DOE facilities such as the Advanced Light Source (ALS) at Lawrence Berkeley National Labs (use of which is highly restricted), making the addition of this resource not only important locally, but regionally and nationally as well, as notably, this would be *the first commercial system of this type in the US*. Thus, this instrument not only adds to our burgeoning capabilities for conducting *in situ* studies of materials, but positions TAMU as a key leader.

The requested instrument will be placed in the current XPS suite in the Materials Characterization Facility (MCF), replacing a nearly decade old system that lacks any in situ capabilities. Placements in the MCF ensures that an existing infrastructure is already in place to ensure apt access and maintenance of this tool. With more than 350 users (68 current for XPS) from 110 research groups on campus along, with a host of outside industrial users. This instrument will support both current and new research, across COE, COS, GEOS and the HSC. A subset of these include the primary faculty on whose behalf this overall request is being submitted, and those key faculty are listed in each section.