<u>Future Research Ideas Andrew Mercado May 30, 2021</u>

<u>1) Anti-Cancer, Bacteria, and Virus Therapeutic</u>

--An engineered particle with three layers that kills only the targeted biologic and the body takes destroyed or dead biologic and "learns" how to defeat live biologics. The particles act like "sticky grenades" that only selectively bond to biologic and thermally affect the biologic (targeted):

A) Zeolite is the core layer that heats up and destroys the biologic with localized thermal decomposition or denaturing of the biologic

B) PLGA layer is the layer that acts like a fuse and a buffer to inhibit the zeolite heating up until is "attached" to the desired biologic. PLGA breaks down in water until the zeolite is exposed to water and then heats up.

C) Antigen for cancer or other targeting biologic that attaches to the biologic that is desired to be destroyed. Antigen or targeting biologic makes the therapeutic target only the desired biologic and needs to have high selectivity.

<u>2) Oxide-Oxide Ceramic Matrix Composite Interfacial and Environmental Barrier Coats</u>

--Based on my UCONN research, ZnO coating for interfacial layer and Al2O3 coating for environmental coating layers with Al2O3 sol-gel for matrix. Al2O3 matrix will strongly bond with Al2O3 environmental layer and weak bonding layer between Al2O3 environmental coating and Nextel 610 Alumina Fiber for fiber pullout and other strengthening mechanisms.

A) Nextel 610 fiber

B) ZnO Interfacial Coating: Precursor Zinc Acetate (we used 41 gm in Aluminum foil boat), Vaporizer Temperature – 215 degrees C to 225 degrees C, Reactor Temperature 400 degrees C, 3 inch tube CVD reactor, 70 SCCM – N2 gas and 30 SCCM – O2 gas

C) Al2O3 Environmental Coating: Aluminum Acetylacetonate, Vaporizer Temperature – 250 degrees C to 300 degrees C, Reactor Temp 400 degrees C to 500 degrees C, Hydrogen to Argon gas ratio 5:1, Oxygen to Argon gas ratio 1:2, Post heat to 1,000 degrees C to 1,100 degrees C for one hour with 1 degree per minute ramp rate, in air

<u>3) Room Temperature Superconductor</u>

--Based on putting pressure on tellurium to make it in the superconducting monoclinic or bcc phase by "pushing" on it with the highly magnetic Neodymium and pushing on it with a reverse magnetic field from a diamagnetic material like Bismuth or Copper. Also, try to get materials that have Fermi energies with small to no "steps" in between them so the electrons can move through the material without too much friction. I think a perovskite structure with the tellurium between the magnetic Neodymium and diamagnetic materials would have enough pressure to force tellurium into the monoclinic or bcc phase when the electrons move through it (maybe Cooper pair type electrons). YNdTeCuO or NdTeCuO

--Use sol-gels? With 25% yttrium (Y), 25% tellurium (Te) and 25% copper (Cu) for cations

1) Replace 50 % of Te with selenium (Se) because a paper said doing that made a higher temperature superconductor.

2) Add 15% Sulphur (S) for higher room temperature superconductivity according to a paper

3) Found paper that tellurium under pressure is superconducting, I think 4 GPa, so was hydrogen sulphide. Maybe recreate this pressure atomically with layering of atoms and moving electrons.

4) Electron Shielding for Relativistic Speed in Space Flight

--Based on electrons giving off light at relativistic speeds and could make a layer of electrons around a ship to protect it and to give off zero mass light to encase and help propel a ship to relativistic speeds. The diamagnetic coated ferromagnetic materials old an electron in a fixed distance from material to "block" projectiles (protection) and produce light at relativistic speeds for propulsion (low coefficient of friction and zero mass for ship to be "pushed" in a direction. Using powder coating set-up from Powdermet, Inc with lab-sized reactor and metal frit to fluidize and coat powder to be injection molded or compressed into parts..

A) Ferromagnetic core particle

B) Thin Diamagnetic coating on core particle, maybe use acetate deposition highlighted for ZnO Interfacial Coating for Oxide-Oxide Ceramic Matrix Composites but change to Copper (Cu) (highly conducting a problem?) or Bismuth (high diamagnetic material—try to use).

5) Electron Scalpel/ "Light Saber"

--Based on Stars wars without using Plasma Torch, For use in cutting, lumber metal, surgery, military items, stationary security (for windows and doors) or other items to cut. A single system with a SEM-like thermionic or field effect emission of electrons (probably thermionic), Bismuth or diamagnetic material –walled, a single crystal window for electron emission like diffraction pattern, and magnets that slow down "slow moving" electrons and make the electrons reverse direction and move like a chain on a chainsaw, with electron as speeding up the closer they get to magnetic field. The interaction with electrons and gas plus the "slowing down of electrons" around Electron scalpel will make it emit light and look like a "light saber". Goal is to make mounted on a machine or handheld.

6) Boron Nitride/Titanium Nitride/Aluminum Nitride/Silicon Nitride/Titanium Carbide/Hafnium Carbide Polymer

--Based on boron nitride's creep resistance for use in Non-Oxide Non-Oxide Ceramic Matrix Composites. Make filaments, discontinuous matrix reinforcement and fabric out of Boron Nitride polymer with spinerettes. Also use Boron Polymer for Polymer impregnation into the composite for Boron Nitride matrix. Trichloroborazine, Aluminum chloride and ammonium chloride, titanium chloride and ammonium chloride, Methyltitaniumtrichloride, silicon chloride and ammonium chloride, Dichloro[bis[trimethylsilyl)amino]titanium (IV) for Ti & Si polymer, methyltrichlorohafnium

A) Use CVD, to coat BN fabric with carbon and then a Boron Nitride Coating with 800 degrees Celsius Reactor Temperature and 1:5 Argon to Hydrogen gas ratio

B) Use polymer as template to make other metal nitride polymers, like Aluminum Nitride, Titanium Nitride, Zirconium Nitride and Hafnium Nitride Polymers for similar Non-Oxide Non-Oxide Ceramic Matrix Composites.

7) Carbon Diamond Polymer

--Based on Silicon Carbide (SiC) preceramic polymer I worked on at UCONN for Pratt and Whitney, change Metyltrichlorosilane precursor, got at Gelest, out for Carbon Tetrachloride. Carbon diamond polymer will be made for use in Non-Oxide Non-Oxide Ceramic Matrix Composites and Gemstones. SiC polymer heated to 1900 degrees C leads to Moissonite, diamond "knock off". May need to heat Carbon diamond polymer to same temperatures and maybe under pressure to get diamonds or without pressure may get grapheme which has its uses. For Non-Oxide Non-Oxide Ceramic Matrix Composites could put a carbon layer between Carbon Diamond polymer fabric and Matrix, like Boron Nitride, for strong light weight panels for car breaks or superstructures for car or airplanes.

8) Thin film earrings for heating head or desalination Lamps or UV lamps

Based on II-VI semiconductor work at UVA, put an thermoelectric or photoelectric optical transparent conducting layer on a window material, then put infrared emitting of ultraviolet (UV) light emitting layer, with a photo conductive layer at the bottom to ground out the charge. I think the cathode layer will have cathode luminescence, will emit light when thermoelectric or photo electric electron pass through it (a thin film light emitter). Infrared light can heat up the back of an ear, desalinate water by evaporating water or create heat. UV emitter could be used for water filtration by killing of biologics in the water or any other decontamination application, like cleaning fumehoods for biologists (a thin film UV lamp). Also in photoelectric configuration could create charge to be harnessed and used for charging batteries or running an electric device. Put a bunch of thin film emitters cheaply for applications and collect charge for storage or use.

9) Gemstone Fabrication

--Based on UCONN sol-gel research and mimicking nature to make colored gemstones via sol-gel fabrication of powder and them melt and let solidify into gemstones. Start with Aluminum oxide (Alumina) Sol-gels and carbon polymer for first gemstones and add different elements for different colors, like Chromium in Alumina for ruby. Mimic nature with material selections to create gemstones in the lab. Need high temperature furnace over 2100 degrees C, want 2400 degrees C, to use Argon as processing gas. MRF Technologies in New Hampshire can rent out furnaces to melt alumina powder or fire carbon diamond polymer to get Alumina Gemstones and diamond, respectively. After get Alumina and diamonds established, do Moissonite, Cubic zirconium (and off shoot to Yttria stabilized Zirconia (YSZ) for fuel cell applications), magnesium oxide, Beryllium Aluminum Silicate (Emerald), and other gemstones.