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1P24 - DESIGN,bUILD, AND TEST OF A LOW COST 3D PRINTED SPECTROMETER FOR EXPLOSIVE COPPER AND CONDUCTIVE POLYMER WIRE EXPERIMENTS

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The field of study of the explosion of metallic conductors has great scientific interest for researchers [1] because of its adjustable input power, low-temperature plasma generation, and production of nanoparticles for materials science applications. X- and Z-pinch configurations of wires are studied across a broad range of pulsed power drivers. The diagnostics for such experiments typically demand very expensive instrumentation due to the specific requirements for operation and control of the system.

Plasma spectroscopy [2] is a noninvasive method capable of characterizing the spectral emission off copper and conductive polymers neutrals and ions during the experiment. A Marx bank generates voltages up to 100 kV in a microsecond time frame and supplies the energy to the wire explosion. Two different materials, copper and polylactic acid (PLA) conductive were evaluated in an air atmospheric pressure during wire explosion. A low-cost lab made spectrometer was manufactured applying the fused deposition modeling (FDM) process[3]. The 3D printed parts for the prototype were designed under constraints of basic optics and plasma spectroscopy diagnostics. The intensity of the light from the explosion was recorded by a fast video camera attached to the spectrometer.

The incorporation of 3D printers for the design of pieces of equipment reduces the cost of manufacturing and acquisition as well as the time for delivery. Furthermore, this tool gives the developer the ability to customize solutions for each experiment more effectively. Experimental data collected with 3D printed spectrometer will be compared with a manufactured commercial version in order to evaluate its performance.
1. J. Jadidian et al., "Visualization of a Copper Wire Explosion in Atmospheric Pressure Air,"IEEE Trans. Plasma Sci., vol. 39,2842,2011.
2. H.J. Kunze Introduction to Plasma Spectroscopy (Springer 2009).
3. D.G. Schniederjans, "Adoption of 3D-Printing Technologies in Manufacturing: A Survey Analysis,"IJPE, vol. 183, Part A, 287, 2017.

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