Characterization of Tungsten Inert Gas (TIG) Welding Fume Generated by Apprentice Welders and Resulting Oxidative Stress Biomarker Analysis

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Tungsten inert gas welding (TIG) represents a widely used metal joining process. Its propensity to generate welding fume particles at the nanoscale poses a potential occupational health hazard. However, current literature lacks data on TIG welding fume characterization as well as on oxidative stress biomarkers in exposed workers. We characterized TIG welding fume generated by apprentice welders (N=20) in an exposure cabin. Exposure assessment was conducted for each apprentice at the breathing zone (BZ) and at a near-field location, and included PM_4, particle number concentration and size, particle morphology, composition, and reactive oxygen species (ROS) production potential. Exhaled breathe condensate, blood and urine was collected before and at three timepoints after exposure to assess biokinetics of oxidative stress biomarkers (total reducing capacity, 8-OHdG, H_20_2, MDA). Mean particle number concentration at the BZ was 1.69E+06 particles/cm^3, with a geometric mean diameter of 45 nm. Across subjects, 92% of the particle counts at the BZ were below 100nm. Mean ROS production potential of TIG welding fumes at the BZ exceeded average concentrations previously found in traffic-polluted air. ROS production potential was significantly higher for apprentices that burned their metal during their welding task, indicating that welding performance may represent a potential exposure modifier. We recommend future exposure assessments consider welding performance as a potential exposure modifier for apprentice welders or welders with minimal training. This comprehensive exposure data will allow a detailed analysis of effects and timing of oxidative stress, for which the laboratory analyses of biomarkers were recently successfully completed.