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All-gas Phase Plasma Synthesis of Plasmonic Zirconium Nitride for Advanced Photochemistry Applications CHRISTOPHER RUDNICKI, LORENZO MANGOLINI, STEPHEN EXARHOS, ALEJANDRO ALVAREZ, University of California Riverside — Plasmonic nanomaterials absorb light extremely well due to a localized surface plasmon resonance that is correlated with the density of free charge carriers in nanomaterials. Plasmonic nanomaterials have received interest in a variety of fields, such as photocatalysis, photovoltaics, biophotonics, spectroscopy, sensing, and wave-guiding. We present a novel technique using a scalable non-thermal plasma process for the synthesis of plasmonic ZrN with 10 nm rock salt crystallinity determined from XRD and TEM that display a plasmonic peak around 620 nm. Cost and more importantly high thermal stability motivate the search for plasmonic materials alternative to gold and silver, like transition metal-nitrides TiN the relatively unexplored ZrN. A second non-thermal plasma reactor is added downstream to coat the particles in flight with an amorphous silicon nitride layer acting as an oxygen-sink when the material is exposed to atmosphere and yields blue-shifted and increased-intensity absorption. Attractive applications of these plasmonic particles are the reduction of metals using visible light like platinum and chromium (VI) species in water which are extremely toxic.

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