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Nano-synthesis of Energetic Materials

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Energetic materials are defined as substances in which fuel and oxidizer react chemically to release energy. The amount and rate of energy released by this reaction can be improved by increasing the amount of interfacial contact between fuel and oxidizer. In conventional energetic materials macroscopic particles of fuel and oxidizer are mixed randomly. In this arrangement energy is lost due decreased contact between fuel and oxidizer as a result of the large particle size and random distribution. To reduce the amount of energy lost much smaller nano-particles can be used. The smaller particles allow for increased interfacial contact between fuel and oxidizer, resulting in improved performance. Even with smaller particles some energy is still lost due to the random arrangement. In order to further improve performance it is necessary to order the arrangement of fuel and oxidizer. Utilizing a method known as surfactant templating ordered structures such as nanorods, nanowires, and nanowells (similar to a honeycomb) can be created from oxide materials such as Copper Oxide, and Iron Oxide. When Aluminum Nano-particle fuel is mixed with these ordered oxide materials the resulting material has greatly increased interfacial contact between fuel and oxidizer. When reacted, these materials have minimal energy loss and greatly improved energetic performance. The increased performance of this type of material has created the possibility of many new applications for energetic materials. The potential uses for this material range from on chip power generation, to shockwave generation for medical imaging.