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Outgassing and gas uptake properties of vacuum and 3D printed materials

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The outgassing rate and gas uptake properties of materials is important for a variety of applications. One example is vacuum; vacuum chambers designed for UHV or XHV (ultra-high or extreme-high vacuum) applications often require outgassing rates on the order of 10-11 Pa L/cm2/s or better, and ultra-low outgassing rates are also required for any materials used within the UHV or XHV systems. Other applications that concern outgassing and gas uptake include gas sensors and gas storage media. Recently, NIST has developed a program for studying outgassing rates and gas uptake properties of materials for the applications mentioned above. However, two specific projects are of primary concern. Firstly, NIST is interested in creating portable sensors based on ultra-cold atoms, such as the cold-atom vacuum standard (CAVS) and other sensors. Such devices will require ultra-low outgassing rates over the lifetime of the device. Outgassing concerns range from the packaging to the alkali-metal dispensers (alkalis such as Rb or Li are used as the cold-atom sensors) to fiber-optic feedthroughs. Materials considered include traditional vacuum materials such as stainless steel, as well as newer materials such as those produced by 3D printing. Second, NIST is interested in studying the gas uptake properties of composite 3D printed materials, such as MOF-ABS composites (metal-organic framework and acrylonitrile butadiene styrene). Such novel and unique materials may be used for gas storage or sensors. Resent outgassing and gas-uptake results from each of these projects will be discussed.

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