

Nitrous oxide – Not a laughing matter in electronics manufacture



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Nitrous oxide (N_2O), often referred to as laughing gas, is used in the high-tech thin film industries of semiconductor and LCD display manufacturing. The primary application is the reaction with silane (SiH_4) or other silicon precursors to produce high-quality oxide films (SiO_x), which are used as electrical insulators in microelectronic transistors.

Nitrous oxide is increasingly used to make thin-film oxides with other elements like titanium, aluminum, magnesium, indium, and zirconium and is also used in the selective etching of semiconductor thin-films.

A colourless, non-flammable gas at room temperature with a slightly sweet odour and taste, N_2O is an oxidiser that can support combustion like oxygen. It is an electronic high-purity material produced from thermal decomposition of ammonium nitrate.

Why is this gas used in electronics manufacturing? It is less reactive, and therefore more selective, than oxygen. Often, this property is used to:

- Control the amount of oxygen in a thin film
- Reduce side oxidation reactions
- Selectively etch one thin film while allowing others to remain.

The current electronics market for N_2O is about 10,000 metric tons per year and increasing. New, higher-definition display technologies like ultra-high definition and OLED require higher amounts of N_2O and are driving a new expansion in usage. N_2O is used to produce metal-oxide transistors, replacing older silicon-based technology,



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and results in screens with faster refresh rates, better colour reproduction, and higher definition images. Where the electronics manufacturing market is concerned, N_2O is clearly no laughing matter – it’s an essential specialty gas product that requires a robust supply chain to match.

In addition to its use in electronics manufacturing, common applications of nitrous oxide are: anaesthetics, as a food and beverage propellant (for whipped cream, for example), as an industrial propellant and foaming agent, and as a fuel oxidiser for rockets and race cars.

While nitrous oxide is one of the global warming compounds addressed by the Kyoto protocol, almost all of the global warming contributions come

from secondary reactions of fertiliser in the soil and other agricultural sources. Electronics use of N_2O is in fact less than 1% of total production and is effectively abated in the fab; therefore, it actually has an insignificant contribution to global warming. 

ABOUT THE AUTHOR

Dr. Paul Stockman is the Head of Market Development at Linde Electronics. Linde produces electronics grade nitrous oxide at sites in Zhengjiang, China; Taichung, Taiwan; and Inju, South Korea. Linde does additional purification and packaging of N_2O at Research Triangle Park, North Carolina.