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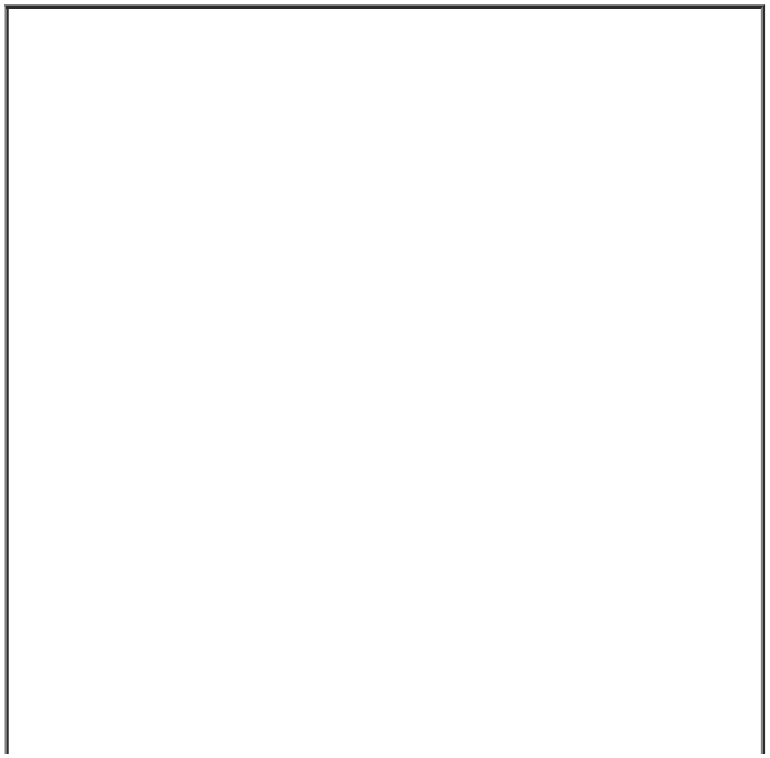
UV-LEDs fabricated with solution process, oxide-in-oxide design

February 24, 2012 -- A team of scientists at Los Alamos National Laboratory has developed a process for creating glass-based, inorganic light-emitting diodes (LEDs) that produce light in the ultraviolet (UV) range, which could lead to biomedical devices with active components made from nanostructured systems.

LEDs based on solution-processed inorganic nanocrystals are inexpensively produced, reliable, and chemically stable even in harsh environments. Los Alamos National Laboratory's Sergio Brovelli, in collaboration with international researchers led by Alberto Paleari at the University of Milano-Bicocca in Italy, created a fabrication process that gets the LEDs to emit UV light.

The glass-based material emits light in the ultraviolet spectrum and can be integrated onto silicon chips. The new devices are inorganic; the glass is chemically inert and mechanically stable, with electric conductivity and electroluminescence. A new synthesis strategy allows fabrication of all inorganic LEDs via a wet-chemistry approach, which is scalable to industrial quantities with a very low start-up cost.



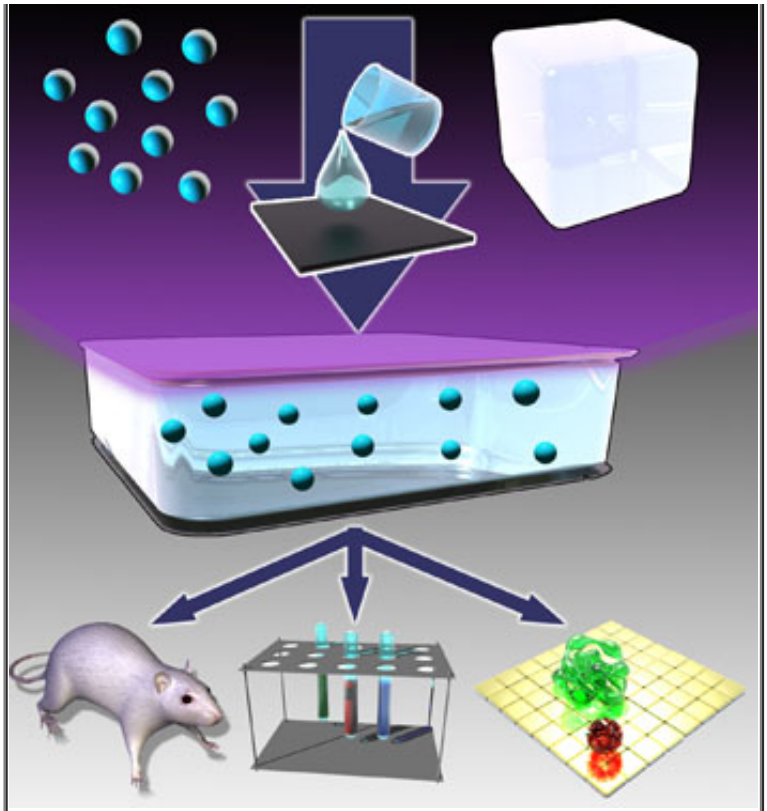


Figure. Embedding nanocrystals in glass creates UV-producing LEDs for biomedical applications. SOURCE: Los Alamos National Laboratory.

The oxide-in-oxide design allows production of a material that behaves as an ensemble of semiconductor junctions distributed in the glass, rather than the sharp interface of two semiconductors found in traditional LEDs. The active part of the device consists of tin dioxide nanocrystals covered with a shell of tin monoxide embedded in standard glass: by tuning the shell thickness is it possible to control the electrical response of the whole material.

LEDs can be integrated in active lab-on-chip diagnostic platforms, or as light sources implanted into the body to trigger photochemical reactions. Such devices could selectively activate light-sensitive drugs for better medical treatment or probe for the presence of fluorescent markers in medical diagnostics.

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The work is reported this week in the online Nature Communications: "Fully inorganic oxide-in-oxide ultraviolet nanocrystal light emitting devices," http://dx.doi.org/10.1038/ncomms1683. Its authors are Sergio Brovelli[1, 2], Norberto Chiodini[1], Roberto Lorenzi[1], Alessandro Lauria[1], Marco Romagnoli[3,4] and Alberto Paleari[1]

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