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SCIENCE NOTEBOOK

Chemistry: Putting Good Vibrations to Work

The good vibrations of "acoustic cavitation," the process previously reported to make water glow, have now been shown to have another, and possibly more useful, property—the ability to turn normally crystalline metals such as iron into the amorphous form best known in glass.

University of Illinois chemists, reporting in the journal Nature, say the process could revolutionize the way many commercially important materials—such as VCR recorder heads—are made. It also appears to have yielded a catalyst 10 times better than had existed for turning coal into liquid fuel.

When certain solids are melted and then cooled, their atoms align themselves into regular arrays called crystals. However, if they are cooled rapidly enough, crystals don't have time to form, and the atoms solidify into random, or amorphous, patterns called glasses. Silicates treated this way become ordinary window glass. But metals, too, can cool into glasses, which are extremely useful for certain industrial applications because they have no "memory effect." That is, they can impart a magnetic imprint onto something like video tape without retaining the signal.

Metallic glasses, however, are extremely difficult to make because they demand very rapid cooling, usually requiring the melted metal to be splattered onto rotating drums cooled by liquid nitrogen. Now, however, Illinois chemist Kenneth Suslick and his colleagues have found a way to produce these glasses by harnessing the unique advantages of acoustic cavitation in a benchtop bubble machine.

As sound waves—in this case at 20,000 cycles per second—travel through a liquid, the expansion phase of the wave causes cavities to form. The following compression phase squashes the cavity, and the force of implosion heats the few gaseous molecules inside the bubble to around 9000° F within a few millionths of a second. The surrounding liquid cools them nearly as fast.

When Suslick's team treated an iron-bearing liquid with ultrasound, it created substantial quantities of amorphous iron. The resulting material proved 10 times more reactive than the crystalline powder used as a catalyst in various industrial reactions, including conversion of coal to liquid fuel.

With this acoustic shake-and-bake, "we have discovered a new way of making amorphous metals," said Suslick, who hopes to continue making waves.

—Curt Suplee