Scintillator Distribution in High-Speed Autoradiography

Durie and Salmon (*1*) describe the technique of impregnation of photographic emulsion with liquid scintillator which allows rapid autoradiographic labeling. In attempting to use this method, we found that freezing the impregnated slides without special conditions led to the formation of large ice crystals and irregularities in the frozen scintillator. They appeared even when the dioxane did not contain either 2,5-diphenyloxazole or 1,4-bis-2-(4-methyl-5-phenyloxazolyl)-benzene. It could be seen clearly with the ultraviolet lamp (UVSL-58, Product Inc., San Gabriel, California).

Crystalline pictures of the scintillator luminescence show that molecules of the fluorescent substance are distributed nonhomogeneously over the biological sample. Hence, distorted distribution of silver grains in developed emulsion layers seems to be inevitable. A crystalline structure can also be seen under light microscopy. In order to circumvent these difficulties, we attempted to obtain uniform coating of the slides with the scintillator by quick deep freezing. The slides were dipped in horizontal position into the precooled isopentane so that the surface of the slide containing the biological sample and the impregnated emulsion remained free. Isopentane was cooled by liquid nitrogen. Rapid deep freezing of the scintillator can be obtained also by spraying the substance on the previously frozen slides, as above.

Examination with an ultraviolet lamp and light microscope of the slices frozen by described techniques shows that crystals are not formed and fluorescent molecules are distributed in a homogeneous way.

We think that the suggested system of rapid freezing can contribute to more correct readings of autoradiograms prepared by the high-speed scintillation autoradiography technique.

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References and Notes

1. B. G. M. Durie and S. E. Salmon, *Science* **190**, 1093 (1975).
2. We thank Dr. Y. Meckler for his comment on using the ultraviolet light.

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The suggestion to circumvent the problem of crystal formation is good and should be helpful for workers who require cooling to low temperatures to maximally enhance grain formation. In the original development of the high-speed scintillation autoradiographic method, moderately rapid freezing (in a deep freezer) to −85°C was used. In our laboratory minimal crystal formation resulted from this cooling procedure. However, cooling to much lower temperatures resulted in serious crystal formation and a cracking of the photographic emulsion. Increasing the concentration of 2,5-diphenyloxazole (PPO) in the scintillator clearly accentuated crystal formation. An unfortunate error in the original report on scintillation autoradiography listed the concentration of PPO as 35 g, which is a very high concentration and does cause significant crystal formation. With the correct concentration of 5 g of PPO we did not find crystal formation to be a significant problem.

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Strange Xenon, Extinct Superheavy Elements, and the Solar Neutrino Puzzle

Anders and co-workers (*1*, *2*) suggest in situ decay of a volatile superheavy element 115 (or 114, 113) to explain the enrichment of heavy Xe isotopes in mineral fractions of the Allende meteorite. We will show (i) that the scenario described by Anders *et al.* (*2*) cannot account for their experimental results, (ii) that these new data provide additional evidence in support of our earlier suggestion (*3*) that the isotopically anomalous Xe in Allende and other carbonaceous chondrites was produced prior to incorporation into meteorite minerals, (iii) that the elemental and isotopic ratios of noble gases in these meteorite minerals contain an important record of the nuclear processes that produced our chemical elements, and (iv) that this record of element synthesis offers a possible explanation for the solar neutrino puzzle (*4*).

In 1957 Burbidge *et al.* (*5*) presented a detailed theory of the synthesis of elements in stars. They showed that fusion and other nuclear reactions that are expected at different stages of stellar evolution could have produced the present elemental and isotopic abundance patterns of all the chemical elements from the lightest element, hydrogen. According to their theory, the heavy and light isotopes of Xe were synthesized in supernova envelopes by rapid neutron capture and proton capture or (γ, n) reactions (r- and p-processes), respectively. Before reaching the supernova stage, nuclear evolution would have consumed light elements from central regions of the star, but the envelopes would remain relatively rich in hydrogen and other light elements. These light elements participate in the rapid nuclear reactions which synthesize the light and heavy Xe isotopes at the time of the supernova, H is consumed by the p-process, and neutrons for the r-process are generated by reactions of ^{4}He on ^{13}C and ^{21}Ne (*5*). Recently there have been several more detailed discussions of yields of the r- and p-processes for all stable Xe isotopes (*6*).

In 1972 we noted (*3*) that carbonaceous chondrites contained an isotopically distinct component of Xe which was enriched in the light and heavy iso-

Table 1. Elemental and isotopic ratios of noble gases in acid-treated mineral fractions of the Allende meteorite (*1*).

Sample	Elemental ratios					Isotopic ratios			
	^{4}He	^{22}Ne	^{36}Ar	^{82}Kr	^{132}Xe	^{124}Xe/^{132}Xe	^{136}Xe/^{132}Xe	^{86}Kr/^{82}Kr	^{80}Kr/^{82}Kr
3C1	6,230	3.79	122	0.254	≡1.00	0.00471	0.338	1.54	0.197
3CS1	7,010	4.08	122	0.241	≡1.00	0.00474	0.338	1.54	0.198
3CS3	11,200	6.91	106	0.225	≡1.00	0.00492	0.354	1.56	0.197
3C3	13,900	8.42	112	0.238	≡1.00	0.00491	0.354	1.56	0.196
3C2	40,100	26.4	92.6	0.176	≡1.00	0.00586	0.461	1.68	0.197
3CS2	47,400*	29.1*	92.2	0.169	≡1.00	0.00616	0.477	1.70	0.197†
3CS4	83,300	48.0	93.4	0.131	≡1.00	0.00727	0.583	1.91	0.190†

*Gases were extracted from 3CS2 by stepwise heating; the He and Ne released at 700° and 1600°C were excluded from the summation for reasons given by Lewis *et al.* (*1*). †Experimental uncertainties are ≥ ± 9 percent in these ratios because of corrections for hydrocarbon background at mass 80.