Technology

Penciling-in chemical concentrations

A titration is one commonly used technique for determining the amount of a substance dissolved in a solvent. The analyst adds a reagent of known concentration (the titrant), which reacts with the substance being measured. A chemical change signals the endpoint when the substance has reacted completely. In a potentiometric titration, a change in the electric potential difference between two dissimilar electrodes, the sensor and the reference, marks the endpoint. Walter S. Selig of the Lawrence Livermore National Laboratory in Livermore, Calif., has designed and tested a simple, inexpensive "universal" sensor that can easily be made in the laboratory.

Selig based his work on earlier reports that polyvinylchloride membranes plasticized with dioctylphthalate respond to some organic negative ions. He demonstrated that a sensor made from this material can be used in a variety of potentiometric titrations, including the determination of the concentration of perchlorate, fluoride, hexafluorophosphate, ferrous and ethylenediamine tetraacetate ions. The sensor can measure both organic and inorganic ions, but because the membrane dissolves in organic solvents, the solutions must be aqueous. Selig reported his studies in ANALYTICAL LETTERS (Vol. 15 [A3], p. 309, 1982).

Selig makes his sensor from a 15-centimeter section of a graphite spectroscopic rod. He dips the rod for a few seconds in the coating solution (polyvinylchloride and dioctylphthalate dissolved in tetrahydrofuran) to a depth of 1.3 centimeters and dries it in the air, repeating the coating process several times. In contrast to commercially available ion-selective electrodes, which cost from $40 to as much as $355, Selig's sensor can be made for pennies.

In a technical tour de force, Selig showed that a graphite "lead" from a mechanical pencil and a No. 2 wooden pencil, when coated with the polyvinylchloride mixture, are perfectly adequate sensors for potentiometric titrations. Selig says, "Though we do not advocate regular use of these two materials, we have demonstrated that in some applications it is possible to do research and write up the results with the same pencil."

Funding for VLSI research

In May, several of the semiconductor industry's largest companies joined to form the Semiconductor Research Corp. (SRC) in order to support basic research in universities (SN: 4/24/82, p. 277). With a projected first-year budget of $6 million, the SRC's board of directors defined, in a broad sense, the topics to be investigated and put the emphasis on long-term research projects in areas such as the design of integrated circuits, manufacturing technologies and quality assurance.

Now the SRC is calling for proposals from university researchers who are interested in studying aspects of very large scale integration (VLSI), the packing of increasingly large numbers of electronic elements onto silicon chips. Robert M. Burger, SRC assistant director, says, "VLSI is the subject area of most important interest to our member companies. A large part of why SRC was founded was to replenish the generic technology in the VLSI area for American industry." The SRC expects to receive a large number of proposals, from which between a dozen and three dozen will be selected for funding.

Since its founding, the SRC has established an office at Research Triangle Park, N.C., and has already solicited research projects from many universities. Burger says, "We are executing contracts for. . .specified research, which they propose to us and which fit into our predetermined agenda." The SRC is also negotiating with several universities to establish major research centers that will focus on specific topics like microstructure. Burger says, "Between now and the end of the year, we expect two of these centers to be established."

Earth Sciences

Flying through driving rain

In recent years, wind shear — rapid shift in wind speed and direction — has been blamed for a spate of airplane crashes including the recent crash of a Pan Am jet near New Orleans in which 145 passengers perished. It is believed that many accidents occur because pilots are unable to compensate for the loss of wing lift during takeoff and landing (SN: 8/21/82, p. 118). Wind shear may have an accomplice in mischief, suggest two researchers from the University of Dayton Research Institute. James Luers and Patrick Haines speculate that heavy rain also may have grave effects on airplane performance because a thick sheet of moving water could change the way air flows over the wing enough to hinder operation. It is not only the quantity of rain that is significant but also the roughness that the rain imparts to the wing's normally smooth surface, they say. Luers, who testified before the National Transportation Safety Board during investigations into the New Orleans crash, hopes to validate the theory through wind tunnel experiments simulating natural heavy rain and the ways aircraft respond when they fly into it. "We're not saying wind shear doesn't exist," Luers says. "We just think that in some of these accidents that if heavy rain were taken into consideration, you would not need nearly as large a wind shear to explain the trajectory the plane took." He says that heavy rains were present during many accidents for which wind shear has been assumed the only external factor. An investigator for the NTSB said that his agency will not comment on the heavy rain theory until the data have been collected and the National Aeronautics and Space Administration, which funded the first two years of the research project, has reviewed them.

More minerals

A new addition to the growing cache of known — but still unminable — mineral ores on the seafloor was discovered recently on a slow-spreading ridge in the Atlantic, the National Oceanic and Atmospheric Administration reports. The mineral deposits, rich in manganese and possibly copper, zinc and silver, are the largest found on a slow-spreading ridge. The minerals formed along the Mid Atlantic Ridge where molten volcanic rock meets cold seawater along cracks where two plates of the earth's crust are moving apart at a rate of inches per year. Geologists participating in the cruise describe the deposits as "shingles" exposed along the wall of the rift valley, in this case 10,000 feet below the ocean surface and 1,800 miles east of Miami. Technology has not yet advanced to the point where it is feasible to mine the deposits. However, the scientists say that increased understanding of the deposits' formation may enhance the search for strategic minerals on land.

Reading the record in red clay

On Leg 86 of the Deep Sea Drilling Project (SN: 10/9/82, p. 231) for the first time scientists went out of their way to collect cores of red clay — a fine-grained material believed to comprise as much as 50 percent of the sediments carpeting the Pacific seafloor. Until recently the clay was of relatively little use to geologists because it lacks the microfossils needed to correlate different periods and events in the geologic record. Pat Doyle of Scripps Institution of Oceanography is working to develop a method of analyzing the clay using bone fragments of fish, including teeth, that do not dissolve even at depths below which most carbonate material dissolves. "Fish do evolve rapidly enough" that one can identify layers and boundaries by the skeletal remains in the clay, she says. The slow rates at which red clays build up makes it possible to collect a fairly short sample of sediment and still span great lengths of time. For example, Doyle says that one sample of red clay 20 meters long (deep) took 65 million years to accumulate.