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Bio-Medical

Simplified Identification of mRNA or DNA in Whole Cells

This test can be performed using compact, low-power equipment.

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A recently invented method of detecting a selected messenger ribonucleic acid (mRNA) or deoxyribonucleic acid (DNA) sequence offers two important advantages over prior such methods: it is simpler and can be implemented by means of compact equipment. The simplification and miniaturization achieved by this invention are such that this method is suitable for use outside laboratories, in field settings in which space and power supplies may be limited.

This method is related to the methods described in "Simplified Microarray Technique for Identifying mRNA in Rare Samples" (ARC-15177-1), *NASA Tech Briefs*, Vol. 31, No. 1 (January 2007), page 60. Like the methods described in the cited prior article as well as older, more complex methods, the present method is based partly on hybridization of nucleic acid, which is a powerful technique for detection of specific complementary nucleic acid sequences and is increasingly being used for detection of changes in gene expression in microarrays containing thousands of gene probes. Like one of the methods described in the cited prior article, the present method provides for identification of mRNA or DNA from whole cells.

In the present method, one begins by preparing one or more reference substance(s) and a reference slide that contains one or more compartment(s) — one compartment for each reference substance. Each reference substance includes a selected mRNA or DNA sequence labeled with horseradish peroxidase. [Preferably, the mRNA or DNA is prepared by polymerase chain reaction (PCR) amplification.] Each reference substance is formulated to be solid at a low storage temperature (about 4 °C) and to become liquid at a higher temperature (no more than about 42 °C). Each reference substance is placed in its assigned compartment on the slide, then the slide is stored under refrigeration until it is used.

One also prepares a plate containing one or more microwell(s). If there is more than one microwell, then the microwells are arrayed in a pattern to register with the compartments containing the reference substances on the slide. Cells to be tested for the selected mRNA or DNA sequence(s) [more specifically, cells that contain substances that may or may not include the selected mRNA or DNA sequence(s)] are prepared by making holes in their membranes large enough to enable molecules of the reference substances to enter. One or more of the cells is placed in each microwell.

At testing time, the reference slide is removed from cold storage and placed in contact with the microwell plate, positioned so that the compartments containing the reference substances are registered with the microwells containing the cells. The plate-and-slide assembly is then warmed to liquefy the reference substances so that they flow into the microwells and through the holes into the cells. The reference substance reacts with substances in the cells, and the products of these reactions are then hybridized. If a cell contains a target substance (a substance that includes the selected mRNA or DNA), then the reference and target substances react to form reference-sequence/target-substance conjugate molecules. The reaction products are treated with a chemiluminescence solution, then illuminated with light in a selected wavelength interval and subjected to a chemiluminescence scan. The presence or a sence of the reference-sequence/target-substance conjugate molecules (and, hence, the presence or absence of the selected mRNA or DNA in the cells) is indicated by the presence or absence of corresponding chemiluminescence spots in the scan image.

This work was done by Eduardo Almeida of Ames Research Center and Geeta Kadambi of National Space Grant Foundation.

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning rights for the commercial use of this invention should be addressed to the Ames Technology Partnerships Division at (650) 604-2954. Refer to ARC-15448-1.

Printed Multi-Turn Loop Antennas for RF Biotelemetry

Compact antennas afford hemispherical coverage at any linear polarization.

John H. Glenn Research Center, Cleveland, Ohio

Printed multi-turn loop antennas have been designed for contactless powering of, and reception of radio signals transmitted by, surgically implantable biotelemetric sensor units operating at frequencies in the vicinity of 300 MHz. In the original intended application of these antennas, the sensor units would be microelectromechanical systems (MEMS)-based devices now being developed for monitoring physiological parameters of humans during space flights. However, these antennas and the sensor units could just as well be used for physiological monitoring on Earth.

Figure 1 depicts one such antenna, consisting of a thin metal strip laid out in a multi-loop pattern on a dielectric substrate. Other components are also mounted on the dielectric substrate. For maximum sensitivity in reception, a Pi network (which comprises lumped-element inductors and capacitors) is used to