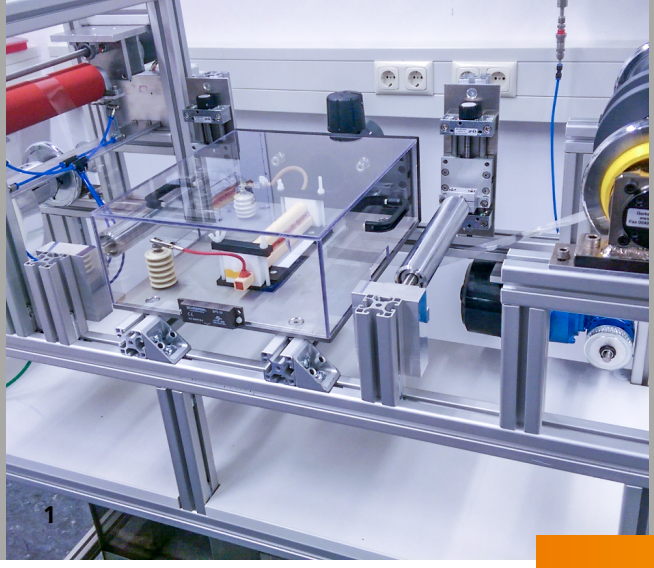

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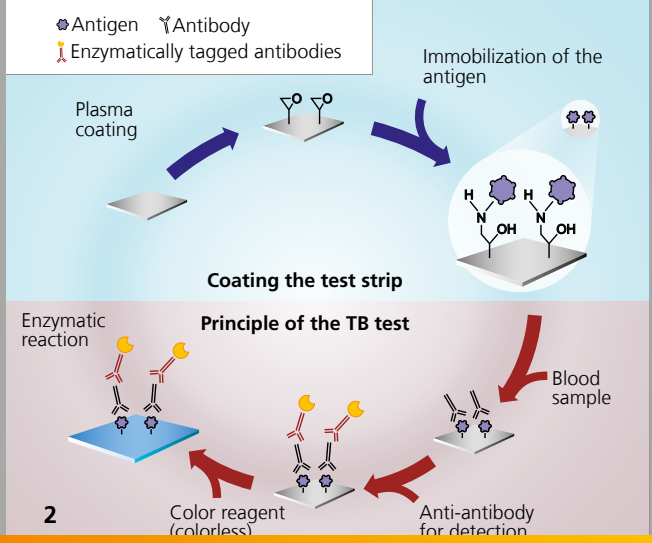

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Extract from the annual report 2016
To the website: www.ist.fraunhofer.de/en.html

TUBERCULOSIS TEST – FASTER AND MORE SENSITIVE DUE TO PLASMA COATING

Even nowadays tuberculosis (TB) is one of the most common fatal infectious diseases worldwide. Around nine million people are infected with tuberculosis each year, of whom around two million die of it. The disease is particularly widespread in developing countries in Asia and Africa. There is therefore a high demand for simple and sensitive test systems with which the disease cannot only be detected early and reliably but also inexpensively and without great outlay on equipment in countries with a less well developed health infrastructure. In the EU-funded "IP4Plasma" research project the Fraunhofer IST is now developing such a test in collaboration with a partner from industry, LIONEX GmbH in Braunschweig.

The test strips

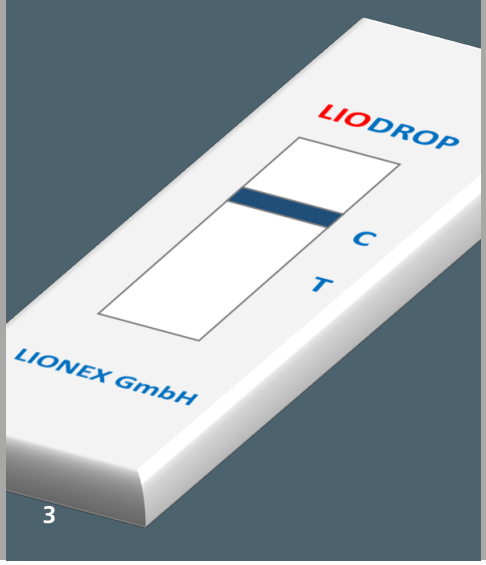
The principle of the test is based on the detection of human TB-specific antibodies from a blood sample which bind to TB antigens on a test strip. Immobilization of the antigens on the surface of the test strip makes a crucial contribution to the sensitivity of the test.

To secure an especially high density of binding possibilities for the antigens, the film surface of the test strips is coated at atmospheric-pressure by a plasma-enhanced chemical vapour deposition (PECVD) process. This "cold" plasma process, also known as dielectric barrier discharge (DBD), is characterized by relatively simple apparatus technology and, unlike other methods, does not use solvents. The coating is only a few nanometers thick and contains a large number of chemically reactive groups, so-called epoxy groups, which bind the antigens covalently. For each test strip two linear areas are plasma coated with epoxy groups. One line serves as the control line "C", with antigens being immobilized here which bind non-specifically to human antibodies. The second line represents the test line ("T"). TB antigens are bound here which are used for the detection of the test subject's tuberculosis antibodies.

Test execution

The test is very simple in performance since no apparatus is required. It is suitable not only for plasma, but also for whole blood and serum, and can be evaluated with the naked eye. The person conducting the test first applies a drop of the blood sample to the test strip. Afterwards, a drop of the reagent solution is added.

If a TB disease is present or if the person already had a TB infection in the past and still has antibodies in the blood, then the TB-specific antibodies will bind by the key-lock principle to the antigens on the test line. Regardless of whether TB-specific antibodies are present or not, every blood sample will always also contain antibodies, which bind to the control



1 *System for coating the test strips.*

2 *Preparation of the surface (top) and the test principle of the tubercolosis test (bottom).*

3-4 *Possible outcomes of the tuberculosis test.*

line. The reagent solution contains an enzymatically tagged antibody – a so-called anti-antibody – which binds to human antibodies. The reaction mixture is removed from the test strip with the aid of a punch and the initially colorless reagent tetramethylbenzidine (TMB) is dripped onto it. Contact with the enzyme brings about a color change to blue.

This result is already visible after a short period of time: if the control line alone turns blue, this indicates no tuberculosis disease is present. At the same time, the blue coloring of the control line shows that the test was performed correctly and also works. If both the test and control lines turn blue, in other words, the observer sees two lines, this is an indication of a possible tuberculosis infection. This test system is highly sensitive that means, even shortly after the onset of the disease a positive result is displayed.

Outlook

The tuberculosis test has already been patented and is currently being further optimized. The goal is to achieve mass-production capability. In addition, it is planned to transfer the test principle to the detection of other viral diseases.

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