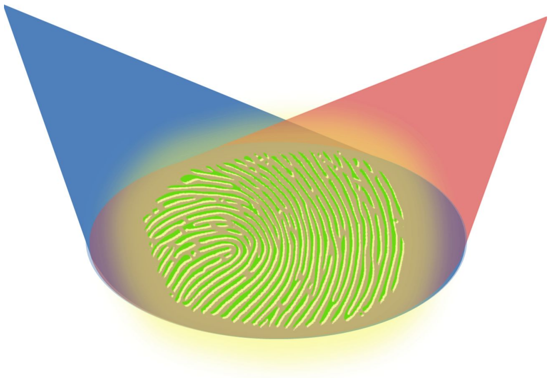

„Every contact leaves a trace" – claims Locard's principle formulated in the beginning of 20th century by a forensic science pioneer dr. Edmond Locard. The principle was further developed by an American chemist and forensic scientist Paul L. Kirk. Kirk writes: "Wherever he steps, whatever he touches, whatever he leaves, even unconsciously, will serve as a silent witness against him. Not only his fingerprints or his footprints, but his hair, the fibers from his clothes, the glass he breaks, the tool mark he leaves, the paint he scratches, the blood or semen he deposits or collects. All of these and more, bear mute witness against him. This is evidence that does not forget. It is not confused by the excitement of the moment. It is not absent because human witnesses are. It is factual evidence. Physical evidence cannot be wrong, it cannot perjure itself, it cannot be wholly absent. Only human failure to find it, study and understand it, can diminish its value."[1]

Very important group of forensic traces are dactyloscopic traces, commonly known as fingerprints. Fingerprint pattern is unique, invariable and indestructible.[2] This unique feature of the human's anatomy allows to use fingerprints to confirm the contact of a particular person with an exhibit.

Except few exceptions, fingerprints are usually invisible with a naked eye and needs to be developed before they can be used as an evidence. The essence of the development is visualization of the latent fingerprint in a way that it is possible to preserve it e.g. by taking a photo.

The simplest way of latent fingermark visualization, known from the criminal movies, is powder dusting. A special powder is introduced on the fingermark surface with a fine brush. The powder sticks to a fingermark ridges making them visible. This method, although frequently used in the real cases, have several drawbacks. It is only suitable for the development of fingermarks on non-porous surfaces such as glass, metal, plastic etc. There is a broad range of physicochemical methods of latent fingermarks development know to the modern forensic science. One knows how to develop different types of fingermarks (sebaceous, eccrine) on the various surfaces. Despite the broad range of accessible techniques development of latent fingermarks on colorful and porous surfaces still remains challenging. Magazines, cardboard packaging, documents etc. belong to the problematic group of surfaces.

Two main features, making above mentioned surfaces problematic, are their color that makes it difficult to get a satisfactory contrast between a developed fingermark an the surface itself and their tendency for a non-specific adsorption of the developing agents. Both problems are already solved if they are encountered separately. The goal of this project is to synthesize a material that will allow to develop latent fingermarks on the surfaces that are porous and colorful in the same time.

To obtain this goal a silica particles will be synthesized. Their surface will be chemically modified in a way that they will bind only to the fingermark ridges, but not to the porous surface. This will allow us to solve the problem of non-specific adsorption of the developing agent on the porous surfaces.

During the synthesis a luminophores will be introduced into the particles. Luminophores, are chemical compounds that show luminescence. Luminescence, in particular photoluminescence is a phenomenon when a mater emits previously adsorbed radiation in a visible range. Usually the luminescence decays rapidly after the excitation pulse is off. Light emission last from single nanoseconds up to microseconds.[3] The dyes and paints used for printing and packaging staining usually behaves this way. However, there is a small group of luminophores that shows so called delayed luminescence which can last even several minutes after the excitation pulse is off. This type of luminophores are going to be introduced into the silica particles.

The fingermark sensitized with luminescent silica particles will be illuminated with an excitation pulse. The pulse will cause the fingermark as well as the background dyes to emit luminescence. However, the background luminescence will decay fast leaving only the fingermark luminescence. After complete decay of the background luminescence the fingermark luminescence will be recorded. (Fig. 1) Thanks to this strategy an appropriate contrast fingermark will be obtained and the colorful background problem will be solved.

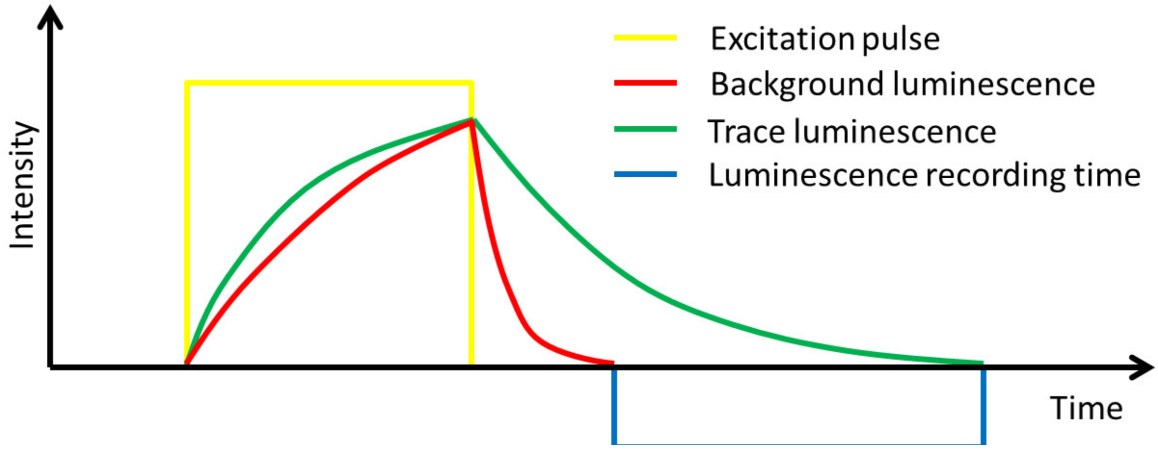

Fig. 1. Excitation, emission and delayed luminescence registration cycle.[4]

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(2) Szczepański, T.; Klemczak, K.; Więckiewicz, U. Probl. Kryminal. 2012, 277 (3), 35.
(3) Kęcki, Z. Podstawy spektroskopii molekularnej; Wydawnictwo Naukowe PWN: Warszawa, 1992.
(4) Moszczyński, J.; Siejca, A.; Ziemnicki, Ł. Probl. Kryminal. 2007, 258, 50.