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A NEW MODELS OF BARRIER DISCHERGE EXCILAMPS FOR LIQUID-PENETRANT INSPECTION

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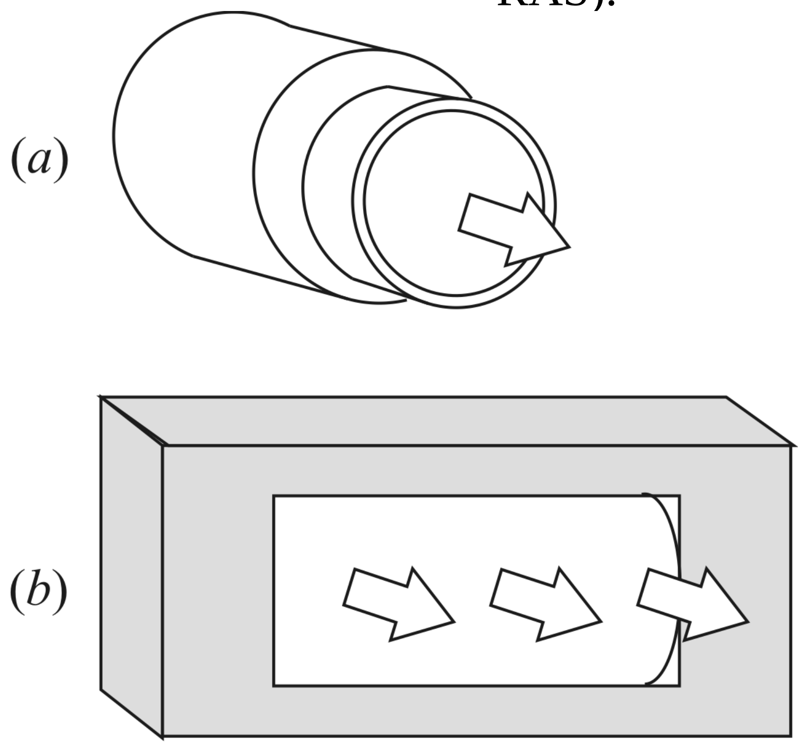
INTRODUCTION

Efficiency of liquid penetrant inspection method (LLPI) depends on the size, brightness and contrast of indications, which depend on the used materials and source of UV radiation[1–4]. The differences in the implementation of the method when using different irradiators (excilamps, mercury UV lamps and UV LEDs) were revealed experimentally[1]. It was shown, that the XeCl-excilamp has the same characteristics as other UV radiation sources.

In now days, LLPI is carried out by means of mercury and LED sources of UV radiation. Each source has its advantages and disadvantages in terms of application and safety. For example, mercury gas-discharge UV lamps provide required testing sensitivity, but require caution in operation and disposal, since they contain mercury. Over the past 10 years, significant progress has been made in the development of reliable excilamps. This is a relatively new family mercury-free sources of UV radiation.

MATERIALS AND METHODS

Four sources of UV radiation were used in comparative studies. These were: LED UV lantern (Labino Torch Spotlight), mercury UV lamp Magnaflux ZB-100F, and two new models of XeCl excilamps for barrier discharge (Institute of High Current Electronics SB RAS).

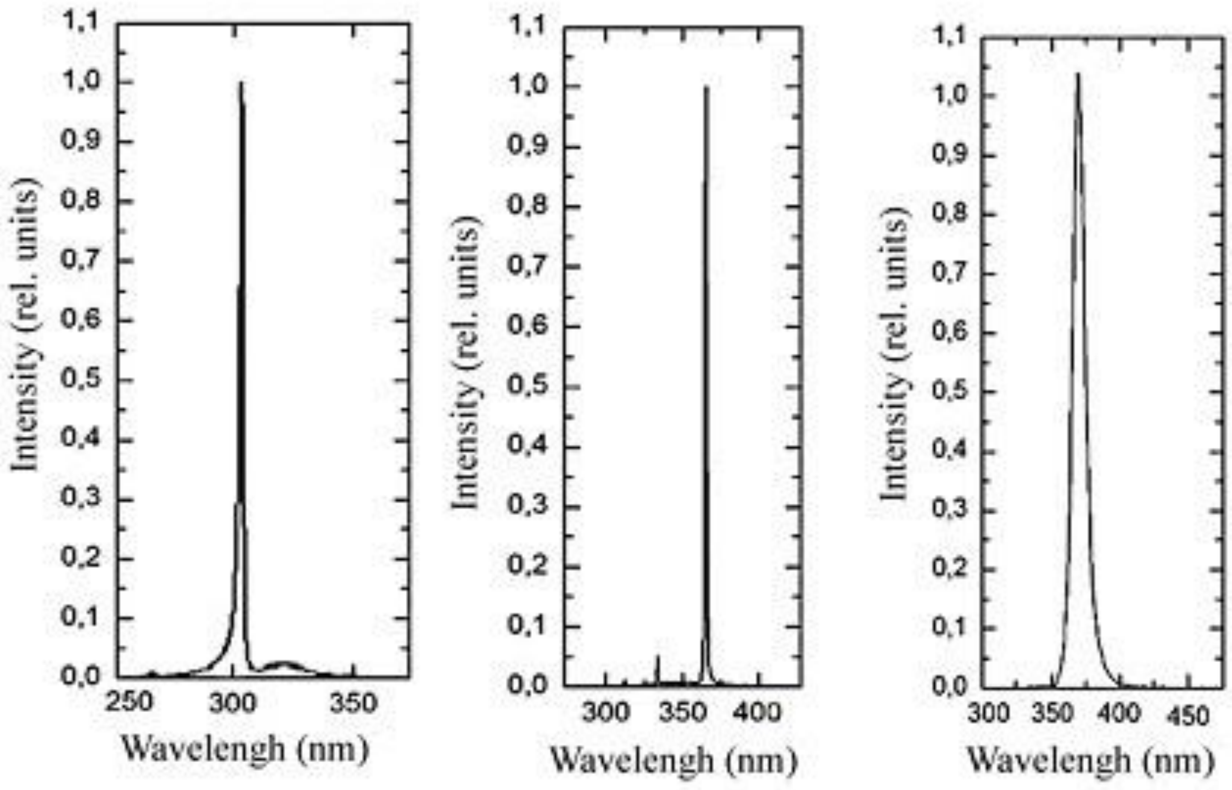


Appearance of portable (a) and frontal (b) barrier discharge excilamps. White arrows indicate the approximate direction of radiation.

The first excilamp (BD_EE model) is a bulb with a flat exit window (22 mm diameter). The lamp is connected to the power supply by a cable up to 1.5 m long. The lamp emits radiation with a maximum wavelength of 308 nm, a half-width band of 1.8 nm, and radiant exitance of up to 70 mW/cm2. The excilamp design provides uniform exposure in the plane of the output window and a high service life of the gas medium. This excilamp is convenient for various sizes irradiating samples and for rapid exposure of various surfaces, which is necessary for LLPI. This excilamp will be called portable. This model be referred to as the frontal excilamp. It has a rectangular exit window with dimensions of 6 by 9 cm and provided a radiant exitance of up to 30 mW/cm2.

Both excilamps are filled with a gas mixture of Xe with Cl2. Under barrier discharge excitation this mixture becomes a source of plasma emitting narrow-band radiation with a maximum at a wavelength of λ = 308 nm. This is the natural spectrum of excilamps. A filter is not required. Mercury UV lamps require using of 365 nm filter. The emission spectra of these sources are shown here.

High sensitivity check samples were used for a comparative assessment of defects detection by various sources UV radiation. One of them – universal test panel Magnaflux Z-5 (PSM-5). After carrying out the entire LLPI procedure the revealed indicator traces were recorded. A series of experiments was performed to compare detection of defects by means of various UV radiation sources and LLPI materials (Magnaflux, Bycotest and Sherwin).



Emission spectra of XeCl excilamps (left), Magnaflux ZB-100F UV lamps (center) and UV-lantern Labino Torch Spotlight (right)

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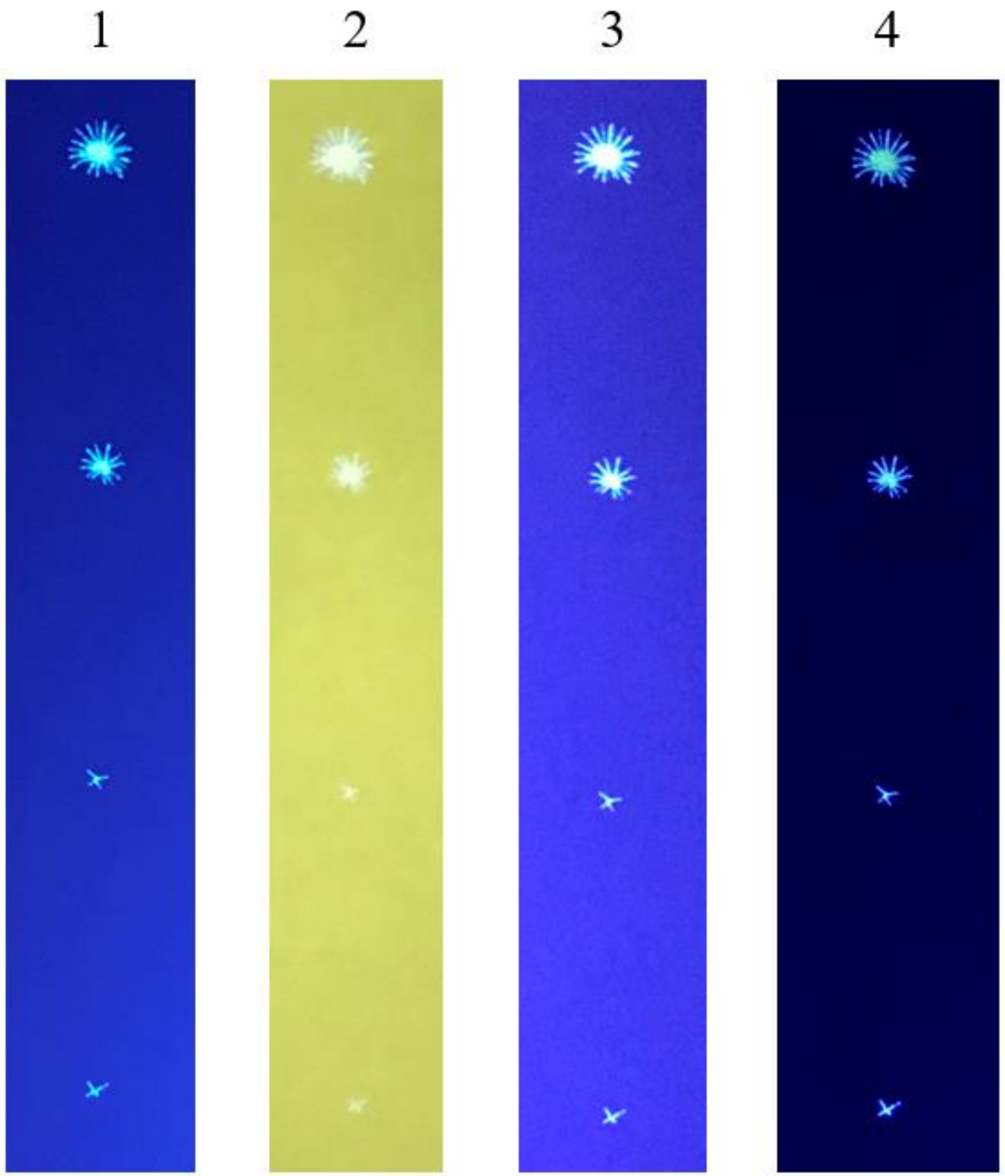
RESULTS AND DISCUSSION

A comparative analysis of the results obtained using various sources of UV radiation to identify indicator traces on the surface of control samples led to the conclusion that all gas-discharge sources of UV radiation showed good results with reliable fixation and identification of indications on check samples.

Excilamps showed good results for fixing indications, better visual perception of information and photos than with using mercury UV lamp. The UV flashlight showed poor results due to background in visible range, and narrow beam field.



Comparative test results using luminescent penetrant SHERWIN HM-3A: 1 – portable excilamp; 2 – LED UV lamp; 3 – frontal excilamp; 4 – Magnaflux ZB-100F.

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Conclusion

This article experimentally compares the esults of LLPI using different UV-light sources (two barrier discharge excilamps (portable and front-mounted), a mercury UV lamp and led UV lantern). It is shown that the XeCl-xcilamp gives a good detection and fixation of indicator traces in comparison with other sources of UV radiation.

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