

We call attention to the difference in the slopes of $\delta(X)$: on going from gold to magnesium, the isomer shift increases for Au^{197} but decreases for Te^{125} . This behavior of $\delta(X)$ for Te^{125} can be explained by starting from the equality of the sign of the change of the charge radius $\Delta R/R$ in Au^{197} and Te^{125} . Whereas in the case of Au^{197} the increase of the isomer shift is connected with the increase of the s-electrons at the nucleus (filling of the 6s shell of gold), the decrease of the isomer shift of Te^{125} should accordingly lead to a decrease of the density of the s-electrons at the nucleus.

Indeed, the valence electrons from the less electronegative metals go over to the Te, fill its p-shell, and decrease the s-electron density at the Te^{125} nucleus by screening. This conclusion agrees with our data on the isomer shifts for halogenide complexes of tellurium [6].

- [1] V. A. Bryukhanov, N. N. Delyagin, and V. S. Shpinel', Zh. Eksp. Teor. Fiz. 47, 80 (1964) [Sov. Phys.-JETP 20, 55 (1965)].
- [2] J. Bara and A. Z. Hryniewicz, Phys. Stat. Sol. 15, 205 (1966).
- [3] P. H. Barrett, R. W. Grant, M. Kaplan, D. A. Keller, and D. A. Shyrley, J. Chem. Phys. 19, 1035 (1963).
- [4] D. A. Shyrley, M. Kaplan, and P. Axel, Phys. Rev. 123, 816 (1961).
- [5] G. A. Bykov and Phan Zuen Hien, Zh. Eksp. Teor. Fiz. 43, 909 (1962) [Sov. Phys.-JETP 16, 646 (1963)].
- [6] V. A. Bryukhanov, B. Z. Iofa, A. A. Opalenko, and V. S. Shpinel', Zh. Neorg. Khim. (J. of Inorg. Chem.) 12, 1985 (1967).

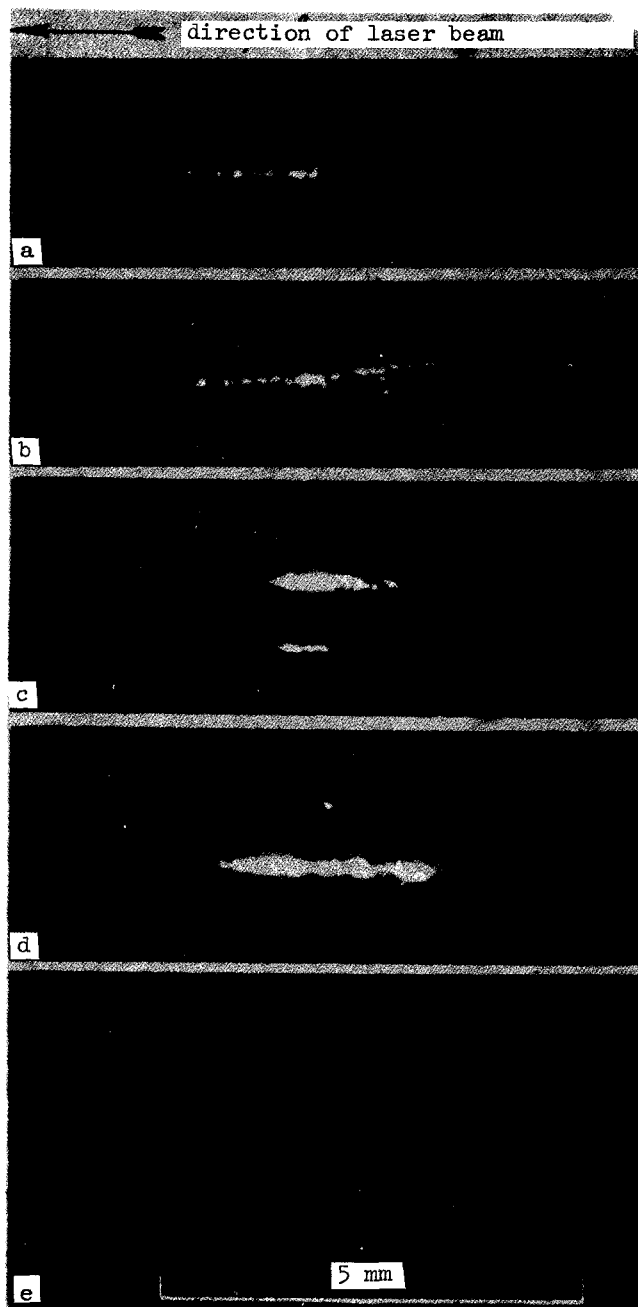
STRUCTURE OF LASER SPARK IMAGE

M. M. Savchenko and V. K. Stepanov
 P. N. Lebedev Physics Institute, USSR Academy of Sciences
 Submitted 5 August 1968
 ZhETF Pis. Red. 8, No. 9, 458-461 (5 November 1968)

Korobkin et al. [1] observed a beadlike structure of the image of a laser spark in air, when photographed in the light of the scattered laser radiation, and advanced the hypothesis that the individual beads can be connected with successive breakdown at the corresponding points; they also made certain assumptions concerning the possible causes of multiple breakdown of this type.

We observed new singularities and the absence of a beadlike structure; this allows us to make different assumptions concerning the nature of this structure. In particular, we have observed that in a number of inert gases there is no beadlike structure.

We used a ruby laser with energy up to 2 J and power up to 100 MW, Q-switched by a rotating prism. There was no mode selection. The electric field vector \vec{E} in the laser beam was oriented vertically. Focusing was by means of lenses with focal lengths from 2 to 20 cm. The spark was photographed integrally in time through a filter that cut off the red light of the laser. The axis of the camera passed through the focus of the length and was located in a plane perpendicular to the laser-beam axis. We note that photographs made simultaneously from two diametrically opposite photography points (Figs. a and b; the camera axis is perpendicular to \vec{E}) do not coincide with respect to the location of the beads, their intensity, and their size, and sometimes also with respect to the prongs of the fork-like structures



light scattered upward (along \vec{E}) is polarized essentially along the beam, i.e., the position of the plane of polarization remains essentially constant. Such a singularity is characteristic of processes of the reflection or refraction type. This situation is illustrated by photographs c (from above) and d (from the side), taken through an Iceland spar plate that separates images with mutually perpendicular polarizations. The quality of the photographs is low, owing to the poor quality of the Iceland spar.

(if the excess over the spark threshold is large and the focal lengths of the lenses are sufficiently short, the red region always has the form of a fork with two or more prongs; we note that the very existence of the prongs cannot be reconciled with the notion of multiple breakdowns). The total amount of laser radiation scattered in opposite directions is also noticeably uneven; it depends on the law governing the drop of the energy flux density in the given direction and the direction of rotation of the Q-switching prism.

If the laser-light scattering is a volume process, of the Rayleigh type, then a photograph taken "from above" (camera axis parallel to the field \vec{E}) should have a negligible intensity compared with a photograph taken from "the side" (camera axis perpendicular to \vec{E}). There are few published data on this topic. Most of them are contained in [2], where measurements yielded for the ratio of the amounts of light scattered perpendicular and parallel to \vec{E} a value equal to 5. In our experiment this ratio equals approximately 2 (it was obtained photoelectrically and photographically).

The laser light scattered laterally (perpendicular to \vec{E}) is polarized essentially along \vec{E} (this can occur both in the case of Rayleigh scattering and in the case of reflection). However, the

We investigated a spark in hydrogen, nitrogen, oxygen, carbon dioxide, chlorine, methane, and in inert gases. All the molecular gases also reveal a beadlike structure and behave like air with respect to the other phenomena noted above.

In noble gases, the spark exhibits significant differences. The filamentary red structured region is missing completely in Xe and Kr. Photographs taken through a red filter have a diffuse character and a droplike form, a low intensity, and almost coincide in form with photographs taken through a violet filter. It is not excluded that they are due to the radiation of the spark itself, which penetrates through the narrow-band red filter. Just as in the case of the radiation of the spark itself, the image of the spark in Xe and Kr, obtained through a red filter, is made up of completely depolarized light (photograph e, taken through a plate of Iceland spar). A structure of very low intensity, consisting of 3 - 5 weak points with large spaces between them, is observed in Ar. They appear against a background of weak diffuse glow of droplike form. While the spark in He gives some structured image in red light, this image is weaker by one order of magnitude, and only the spark in Ne reveals a very weak red structure. We note that the photograph of the spark in its own light (and not in the scattered laser light) has a diffuse character, without a structured region, for all the gases.

It follows from the foregoing results that the image of the spark, obtained in scattered (or reflected) laser light, is more readily connected not with the volume breakdown processes, but with processes that develop on the surface of the spark. These processes are not necessarily connected with scattering by individual electrons. They may also be due to strong fluctuations and drops in the refractive index, due to dissociation or excitation of neutral atoms. The velocity of the scattering or reflection front need not necessarily coincide with the velocity of the matter at the corresponding point. The structure (beads) may be simply connected with a unique type of a "roughness" of the scattering or reflecting surface.

We note that the image of a bearing needle illuminated with laser light (the needle was made of thin steel wire and used to obtain spatial correspondence between photographs made simultaneously from different sides) reveals both a beadlike structure and the polarization peculiarities similar to those noted above.

The authors thank G. A. Askar'yan for advice and a discussion.

- [1] V. V. Korobkin, S. L. Mandel'shtam, P. P. Pashinin, A. V. Prokhideev, A. N. Prokhorov, N. K. Sukhodrev, and M. Ya. Shchelev, *Zh. Eksp. Teor. Fiz.* 53, 116 (1967) [*Sov. Phys.-JETP* 26, 79 (1968)].
- [2] M. Young, M. Hercher, and Chung-Jin Wu, *J. Appl. Phys.* 37, 4938 (1966).