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THE EFFECT OF REDUCING THE DURATION OF THE CURRENT FRONT ON THE RADIATION OF MULTI-WIRE HIGH-CURRENT Z-PINCHES *)

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The paper presents the results of experiments to increase the specific plasma energy concentration of high-current Z-pinches by using various compression modes. Experiments were carried out with cylindrical wire assemblies at the Angara-5-1 installation with a load current of up to 4 MA. The use of a plasma disconnector to sharpen the current front on a cylindrical wire load led to a significant increase in the energy and power of soft X-ray radiation of a high-current Z-pinch. The results of experiments with a plasma breaker are compared with the results of experiments on radiation generation by multi-wire cascade cylindrical assemblies with reduced inductance at the final stage of pinch compression. When compressing cascaded multi-wire tungsten assemblies with reduced inductance at the final stage of compression, the power of soft X-ray radiation from a pinch with a length of 1 cm at the level of 10-11 TW was obtained, which corresponds to the radiation power from a pinch with a standard length of 1.6 cm at the level of 16-17 TW [3]. The specific yield of soft X-ray radiation measured by a thermocouple calorimeter was ~ 150 kJ/cm. The high total and specific radiation powers obtained in this case are associated with the formation of a quasi-continuous compact shell from the internal assembly due to the initial inter-wire distance of only 260-290 microns and a rapid increase in current in it due to compression by the external accelerated shell of the magnetic flux generated by the current of the internal assembly.

In both considered experiments, the process of transition of the wire material from the metal-droplet-vapor state to plasma is significantly reduced due to the quadratic dependence of the plasma formation rate on the current value [2,3]. At the same time, the amount of preplasma on the pinch axis should decrease, and the resulting shell should have a more uniform density distribution over thickness.

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