Brief information about the project

Name of the project	AR15473243 "Application of focused pulsed plasma flows to modify the surface of materials"
Relevance	The project solves the problem of creating new materials of practical importance for industrial use, which can only be obtained using the technology of processing the material with concentrated plasma flows with a high-power density. The idea is that when sputtering a target material with an energy density of (1÷100) MW/cm2, a surface plasma is created from the sputtered material with unique parameters, which, when deposited on the substrate, forms various structural formations (dense micro- and nano-sized particles, structures etc.), and the surface itself is subject to modification during melting and subsequent high-speed crystallization. The experiments will mainly use the applicants' own installation of a pulsed plasma accelerator IPU (KPU-30), created based on KazNU named after. al-Farabi, as well as some of the experiments will be carried out on a "Plasma Focus" type installation.
Purpose	The goal of the project is to experimentally study the effects of high-power plasma flows focused on the surface of substrates and to develop technology for modifying the surface of materials with plasma flows of various compositions.
Objectives	1. Assess the parameters of the surface plasma density, the level of UV and X-ray radiation from the PF plasma region. Data will be obtained on the parameters of the plasma and the emission of the ion flux from the PF region. 2. Conduct experiments on erosion and destruction of the surface of structural materials of nuclear power when the target is exposed to plasma flows with a high energy density of 10÷100 J/cm2 on the KPU-30 and PF-4 installations with microsecond current pulses with an amplitude of 10÷500 kA. Samples of basic structural materials exposed to plasma flows on the KPU-30 and Pf-4 installations at various doses will be obtained. 3. Analyze and investigate surface structural changes, composition and physicochemical properties of the resulting new materials using TEM and SEM methods, ion sputtering, X-ray diffraction, microhardness, etc. The size and quality of defects in the structure of structural materials will be determined, the chemical composition and microstructure of the surface will be determined layer, the relationship between these parameters and the flow parameters is determined.

	4. Conduct a study of the process of sputtering titanium and aluminum targets with powerful plasma streams of argon, nitrogen and oxygen to produce composites.
Expected and achieved results	The expected scientific and socio-economic effect from the project is high. When modifying the surface properties of structural materials in production, savings are achieved on expensive grades of materials due to their partial replacement with lower grades. This will make it possible to produce goods with a high added value, which has high social significance. Applicability and/or commercializability of the obtained scientific results: will be applied in the space and energy industries, including with a private partner. The areas of application of new materials cover almost all industrial sectors. These also include the production of radiation and heat-resistant products (materials), the study of erosion and destruction processes when targets are sputtered by powerful focused plasma flows, and much more. As well as experimental results, they can be used to accurately predict further scientific results obtained by using methods of sputtering metal targets due to the influence of powerful focused plasma flows and solving problems of modifying structural materials.
Research team members with their identifiers (Scopus Author ID, Researcher ID, ORCID, if available) and links to relevant profiles	Head: Moldabekov Zh.M.
List of publications with links to them	1. Жукешов А.М., Габдуллина А.Т., Мухамедрысқызы М., Молдабеков Ж.М. Импульсные потоки плазмы как перспективный инструмент в технологии материаловедения // Вестник КазНИТУ, 2017. - №4. – С. 246-251 2. A.M. Zhukeshov, B.M.Ibraev, A.U. Amrenova, Zh.M. Moldabekov, K. Serik. The pulsed plasma accelerator with focusing electrodes experiments// IEEE International pulsed power conference paper (18-22 June, 2017), 2018. – P.70. - ISSN: 2158-4923. - DOI: 1109/PPC2017.8291282 3. Молдабеков Ж.М., Жукешов А.М., Габдуллина А.Т., Амренова А.У., Серик К. Влияние импульсной плазмы на эрозию поверхности металлических материалов// Вестник НЯЦ РК, 2018. - №1. – С.97-101 4. Жукешов А.М. , Амренова А.У., Габдуллина А.Т., Молдабеков Ж.М. Определение параметров плазмы на установке «Плазменный фокус» // "Вестник КазНУ", 2018. - №2. – С. 22–26 5. Zhukeshov A., Nikulin V., Gabdullina A., Mukhamedryskyzy M., Moldabekov, Z. The pulse plasma flows application in material science and nanotechnology //AIP

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Patents	patentable