Gene delivery is crucial for advanced and personalized therapies and diagnoses. Among the most promising vectors are lipid-based nanoparticles (LBNPs), which offer several advantages over traditional vectors, such as viruses. LBNPs are extensively used to encapsulate RNA. However, DNA encapsulation is still challenging, and the transfection efficiency is limited. For this reason, a system that facilitates and quantifies the DNA release from LBNPs is highly desired. Gold nanoparticles, such as rods (AuNRs), offer a valuable support to address this challenge, thanks to their sensitivity to changes in the refractive index (*n*) of the surrounding medium and their ability to convert resonant light into heat (photo-thermal effect). We have previously developed a biosensor based on an AuNRs-DNA array, capable of detecting the hybridization between two complementary oligonucleotide sequences, using several readout techniques. In light of these findings**,** we report the integration of an AuNRs array with liposome/ssDNA complexes (lipoplexes). The resulting bio-nanoplatform exploits the AuNRs-DNA array as a light-to-heat transducer to stimulate the release of ssDNA from the lipoplexes. At the same time, it enables the optical detection of the DNA released delivered from LBNPs by exploiting the hybridization with its complementary sequence previously immobilized onto the AuNRs-DNA array. Furthermore, the AuNRs-DNA array was shown to be non-cytotoxic and suitable for substrate-mediated reverse transfection in a cellular environment.