Proceedings of the

XI INTERNATIONAL CONFERENCE «ELECTRONICS AND APPLIED PHYSICS»

October, 21-24, 2015, Kyiv, Ukraine

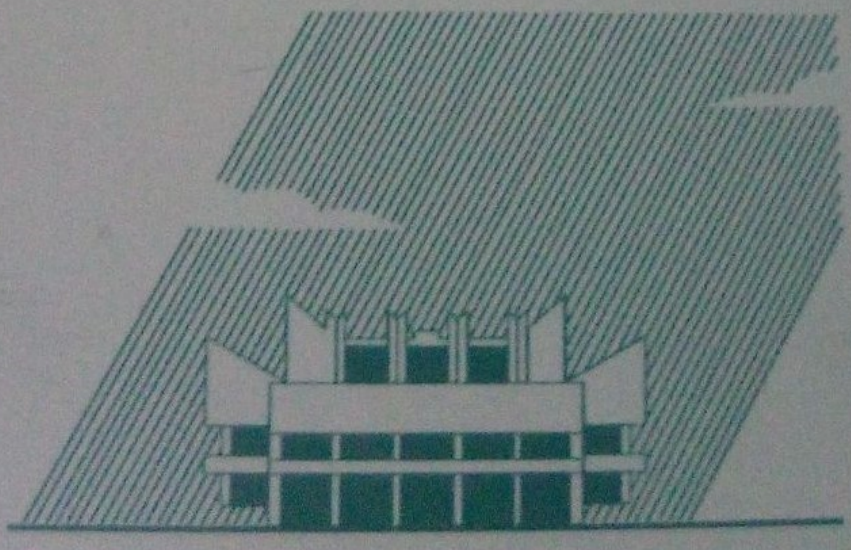
Taras Shevchenko National University of Kyiv
Faculty of RadioPhysics, Electronics and Computer Systems

Праці

XI МІЖНАРОДНОЇ КОНФЕРЕНЦІЇ «ЕЛЕКТРОНІКА ТА ПРИКЛАДНА ФІЗИКА»

21-24 жовтня 2015 року, Київ, Україна

Київський національний університет імені Тараса Шевченка
Факультет радіофізики, електроніки та комп'ютерних систем



FEMTOSECOND FIBER LASER FOR HAIR REMOVAL

Gnatenko A.S., Aleksieieva K.D., Vasko K.A.
Kharkiv National University of Radio Electronics,
61000, Lenina ave,14,Kharkov,Ukraine, e-mail: gnatenko-s@mail.ru

Abstract: *In this study, we investigated the possibility of using erbium-doped fiber ring femtosecond laser for hair removal. Nowadays, femtosecond lasers are widely used in medicine, but we hypothesized that they may also be used in cosmetology. Having received the second harmonic of a femtosecond erbium fiber laser, namely 775 nm, we can affect the hair, thereby effectively removing it from the skin.*

Introduction

Lasers are widely used in medicine and cosmetology. However, laser influence on the skin is applied much more frequently than on other tissues. This is associated with variety skin diseases and different cosmetic defects and the simplicity of the procedures that are associated with the surface of a subject, which need treatment. For hair removal is used the wavelength range 620-740 nm, which corresponds to the red absorption spectrum. Radiation of this wavelength penetrates most deeply into the skin and well absorbed by melanin (region of maximum absorption of 350-700 nm). Red light is very poorly absorbed by the lipids, proteins (proteins absorption maximum is 280 nm) and nucleic acids (absorption maximum near 260 nm), therefore it does not cause lipid peroxidation and does not cause mutagenicity. The most suitable for hair removal light generated: ruby, alexandrite, diode, and neodymium (Nd: YAG) lasers. Special attention should alexandrite laser, because it is better than other types of lasers interacts with melanin. The purpose of this work was to study the fiber ring femtosecond laser for hair removal. This laser been chosen not casually, after receiving the second harmonic of a femtosecond erbium laser, we obtain the wavelength range of the alexandrite laser (λ = 755 nm). This means that it can be used for epilation.

1. The use of lasers in cosmetology

Hair removal refers to operations aimed at selectively damage subcutaneous structures without damaging the integrity of the epidermis. In the latter case, the procedure is the key to selection of the characteristics of the laser radiation is selectively absorbed in these structures, but not in the epidermis. This objective achieved by selecting wavelength and the irradiation conditions which provide the absorption of laser light chromophore (colored target structure) which leads to its degradation or discoloration due to the transition radiation energy into heat (photothermolysis), and sometimes into mechanical energy. In case the hair removal for laser light to the target are stem cells, and the absorbing chromophore is melanin hair shaft [1]. Each structure has a specific range of skin absorption. Fig. 1 shows the absorption spectra of basic chromophores skin. There is a so-called "melanin spot." This wave spectrum, which makes sense to work if we are to hit the melanin and minimize the impact on other chromophores. In "window" misses radiation generated ruby (694 nm), alexandrite (755 nm), a diode (800 nm) and Nd: YAG (1064 nm) lasers. All of them except for ruby laser, currently used in specific devices for hair removal, it is indicating that the "best" of the light source there shown and kinds of emitters are more or less comparable in their effectiveness[2].

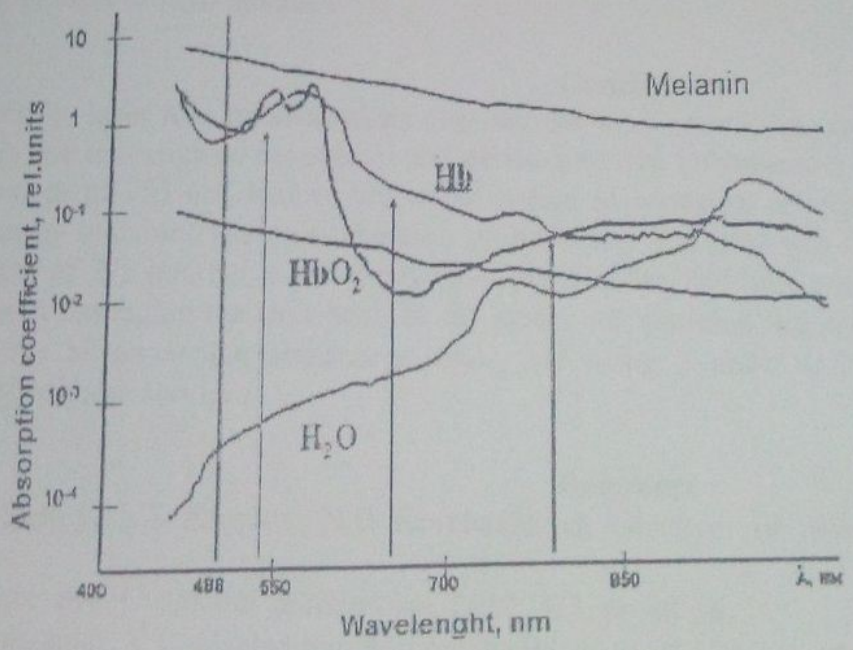


Figure 1. The absorption spectrum of the main skin chromophores

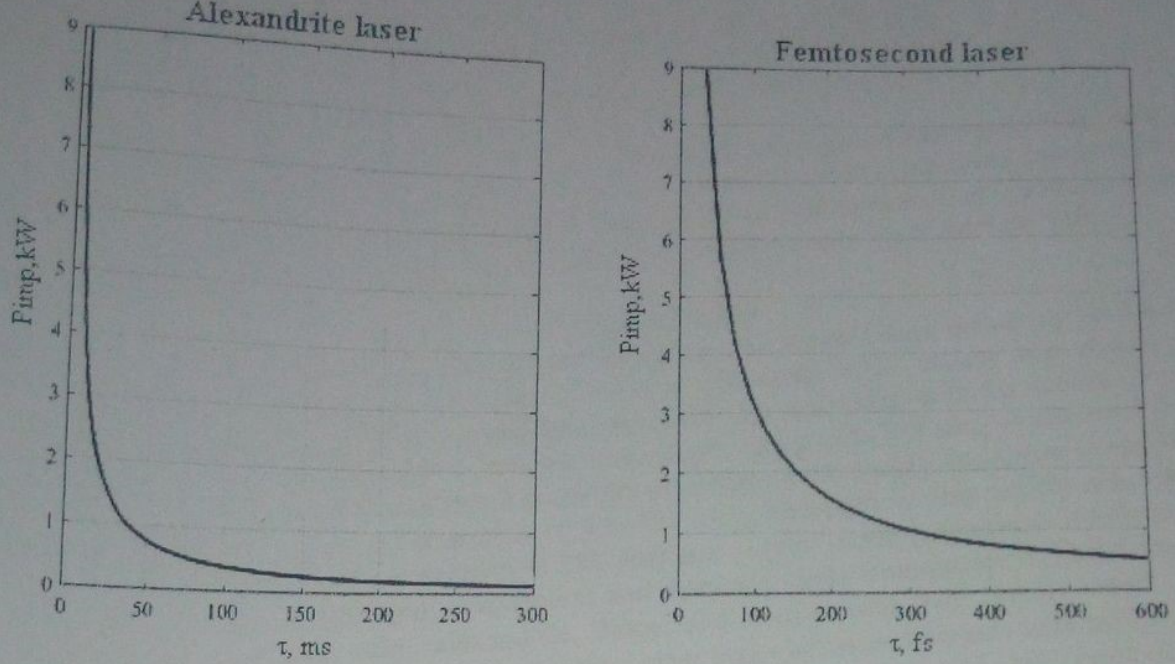


Figure. 2 Dependence of the pulse width of the output pulse

As mentioned previously, the most commonly used in hair removal is alexandrite laser. The radiation of the laser has a wavelength of 755 nm, that is, lies in the region of minimum absorption by hemoglobin and absorption maximum by melanin. The pulse duration is 3 - 300 ms. Pumping is carried out in a green or blue visible range. The energy density of the beam diameter of 10 mm is about 50 J / cm^2. Options offered by us are in the laser pulse duration of femtosecond order [3-6], the average power of about 20 mW, and a pulse energy of 0.5 nJ. Figure 2 shows the dependence of peak power per pulse for the two types of lasers: alexandrite and offered us a femtosecond. From the dependence can be easily determined that the femtosecond laser different pulse durations, not even the shortest has similar settings with power alexandrite laser. But fiber laser with very little energy, which in turn allows more efficient removal of hair, with less thermal influence on the skin, which in turn reduces the amount of hair removal sessions, compared with existing models of laser epilators.

Conclusion

Currently, laser hair removal techniques are the most promising group of methods for hair removal. In this study, we investigated the options and alexandrite ring femtosecond laser. Alexandrite laser radiation has a wavelength of 755 nm, that is, lies in the region of minimum absorption by hemoglobin and absorption maximum by melanin. The pulse duration of 3-300 ms. The proposed fiber femtosecond laser operates at a wavelength of 775 nm, but it has a very short pulse width, and little energy, that can effectively remove the hair without damaging the skin heat. In the study, we assumed that the femtosecond laser can be used in cosmetology as an analog alexandrite laser, and using it could fall sessions procedures, not least for consumers of these services.

Reference

[1] O.V Shepty, L.S Kruglov, N.B Korchazhkina, Observer of new medical technologies, 2014, №1, pp.45-50.

[2] N. Grigoryeva, Cosmetics & Medicine, 2012, №3, pp.48-56.

[3] A.S. Gnatenko, Y.P. Machekhin, Radiotechnics, 2014, №178, pp. 48—51.

[4] M. Salhi, H. Leblond, and F. Sanchez, Physical Review, 2003, A67, pp 1130-1131.

[5] A. S. Gnatenko, Yu.P. Machekhin. Telecommunications and Radio Engineering, 2015, Vol.74, Issue 7, pp.641-647.

[6] A.S. Gnatenko, K.D. Aleksieieva, Radiotechnics, 2015, №182 , pp.51-55.