Гавенко Светлана Федоровна
Svitlana F. Havenko
Украинская академия печати
Ukrainian Academy of Printing
Заведующая кафедрой технологии печатних изданий и упаковки
Head of printing technology and packaging
д. т. н. / профессор
Doctor of Technical Sciences / Professor
E-Mail: havenko@point.lviv.ua

Елена Георгиевна Котмальова
Elena G. Kotmaljova
Украинская академия печати
Ukrainian Academy of Printing
Аспирант / postgraduate
E-Mail: llena_k@yahoo.com

Лабецкая Марта Тарасовна
Marta T. Labetska
Украинская академия печати
Ukrainian Academy of Printing
Аспирант/postgraduate
E-Mail: marta_motyka@mail.ru

Хаджинова Светлана Евстахиевна
Svitlana Y. Khadzhynova
Лодзинский технический университет
Technical university of Lodz
заместитель директора Института бумаги и полиграфии
Deputy director of Institute of paper and printing
К.т.н. / dr.eng.
E-Mail: svitlana.khadzhynowa@p.lodz.pl

05.00.00 Технические науки

Использование аромополиграфии для облагораживания и маркировки печатной продукции

Using aromoprinting for finishing and labeling printing products

Аннотация: Аромополиграфия занимает значительное место среди современных технологий облагораживания упаковок, которые улучшают не только дизайн, но и, благодаря использованию аромофарб или аромолаков, уровень восприятия информации о продуктах. В работе исследованы аромоизображения, нанесенные на картон офсетным и трафаретным способом печати, с закрытой презентацией аромата. Установлено влияние внешних факторов (охлаждения, нагревания и УФ-излучения), времени и частоты использования таких изображений на смену стабильности и интенсивности их аромата. Результаты электронной микроскопии показали характер взаимодействия аромокомпозиций и запечатываемого материала при различных способах печати, а также изменение структуры аромопокрытия после использования. Установлено, что метод микрокапсулирования, величина микрокапсул,

их диаметр и толщина мембраны оказывает существенное влияние на качество аромоизображений. В результате сравнения технологий нанесения аромоизображений определены требования к микрокапсулам, входящим в состав ароматической композиции. Подтверждено, что аромолаки могут успешно использоваться для офсетной и трафаретной способов печати при оформлении и маркировке упаковок согласно их назначению.

The Abstract: Aroma printing has considerable space among modern technology of decoration packaging products, which improve not only the design, but also, in consequence of using aroma ink or aroma varnish, enhance the perception of information about products. Aroma images with a closed presentation fragrances created by offset and screen printing on cardboard are conducted. The influence of time and frequency of use, impact factors (cooling, heating and UV-light) on the change of stability and fragrance intensity of printed aroma images. Electron microscopy shows the interaction of aroma varnish and cardboard-base when printing in different ways, the structure changing of the aroma covers after use. It is conducted, that microencapsulation methods, the value of microcapsules, the ratio of the diameter and thickness of the capsule membrane influence on fragranced image quality. As a result of comparison of applying fragranced images printing technologies, set requirements for substances for microencapsulation of aroma composition. It is confirmed that aroma varnish can be used successfully in offset and screen printing for decoration and labeling packaging according to their destination.

Ключевые слова: Аромополиграфия, УФ-лак, аромокапсулы, микроструктура, электронная микроскопия.

Keywords: Aroma printing, UV-varnish, aroma capsule, microstructure, electron microscopy.

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Introduction

Conducted marketing studies show that odors are remembered better and longer than any visual images. Therefore, manufacturers of luxury packing are seeking not only to improve their construction, design, but also attract buyer’s attention to their products by modern printing technologies. Among these technologies aroma printing intensively develops, that uses aroma inks and aroma varnishes, which covers printed images to for open or close fragrances presentation. Aroma inks and varnishes can be successfully used to finish packing, depending on their destination, by different printing methods - offset, screen, gravure and flexographic printing [2].

The best way for fragrances of small print runs is digital inkjet printing, which can be done by using aroma printers and aroma cartridges, ensuring the continued presentation of fragrances. Aroma printing is a promising area not only for decoration promotional and packaging products. To strengthen the effects of tactile perception of information about objects by blind and visually impaired people can successfully apply aroma varnish or ink when applied relief-dot images in Braille on pharmaceuticals, foods or any other packaging [7]. Psychologists studying the effects of odors on the subconscious feelings, thoughts and behavior, confirmed the findings of Alan Hirsch, a noted researcher odors, founder of research odors and tastes, finding that fragrances - is the factor that controls the behavior of the consumer at the time of selection, purchase or use goods. Therefore, the use of aroma printing is an urgent problem nowadays and requires deep fundamental-applied and scientific research.

Problem statement

Application of aroma printing for continuous, selective or fragmentize decoration of printed promotional and packaging products implemented by continuous outdoor, indoor and temporary presentations of fragrances. Fragranced offset and screen inks are water-based dispersion (this group is characterized by reduced viscosity and thixotropic and introduced damping and adhesion additives let to use them for fragrances images not absorbent surfaces, they have a high rate fixing, improving adhesion occurs through priming the surface by UV primers or additive to aroma varnish 10% UV varnish, while applying UV dryers with minimal power). Alcohol aroma varnishes are a mixture of aroma capsules uniformly distributed in the dispersion of polymer film, creators and alcohol solvents; this group of varnishes suitable for coating all types of surfaces. But because of the high speed drying and solvent through the reactivity of microcapsules and their own substantial odor they have not found widespread use. UV aroma varnish is a mixture of aroma capsules in PP compositions suitable for all surfaces. However, these varnishes have some problems with the stabilization of the mixture for a long time [5].

Use of varnishes and inks based on aromatic microcapsules provides a predictive and stable result. The main advantage of this fragrances method is that the fragrance is released only when it is necessary, and in the absence of exposure, the smell can be stored for 2 to 3 years. Aromatic capsule can be added to inks, varnishes and adhesives. Each of these approaches has its advantages and disadvantages. For creating the fragranced effect microcapsules are added directly to the triad or additional inks [8].

As you know, the production of aroma varnishes based on encapsulation, i.e. placement of liquid or pasty substances in closed solid membrane size from 2 to 50 microns. Size of capsules in varnish for offset printing is 2.5 microns, screen printing -10-50 microns. Membrane of microcapsules used for its mechanical protection and long-term storage odors.

It should be noted that the capsule in size 6 microns, have a small amount (about 0.113 mkm^2), but the great strength of membrane, and capsules in size 10 microns opposite: greater volume (about 0.524 mkm^2), but less strength of membrane.

The structure of the microcapsules' membrane may contain of natural substance (wax, gelatin, starch) or synthetic (acrylates, synthetic cellulose, modified starch and other polymers).

This set of components specifically designed to serve as a reliable mechanical protection and for controlled (with a possible delay in time) release of fragrance.

Fragrance's researchers warn that substance intended for microencapsulation, can not consist of substances that are soluble in water. Their boiling temperature should not exceed 100 °C. In addition, there are serious limitations, since it is impossible to introduce products containing alcohol in microcapsules.

To protect the microcapsules from premature destruction used so-called gap constraints. It's round, hard balls made of artificial resin, slightly more microcapsules' size, whose number in the finished print mass is 2-7%. They were placed in designed for processing product with microcapsules. Microcapsules should be evenly distributed in the substrate. The main task of specialists is in any case not to destroy them with stirring. It is generally accepted that a decrease in the radius leads to membrane thickness and mechanical strength increases, and conversely. This is extremely important because for mechanical destruction and release of capsule contents need some pressure [4].

The aim of the research was to found interaction features of aroma varnishes and substrate of paperboard packages, changing the structure of the surface and the intensity of the smell of fragranced images deposited by offset and screen printing under the influence of external factors.

Experiment equipment and method

The objects of research were chosen printing cardboard Alaska GC-2 with basis weight 250 g/m². Printing were conducted at offset sheet machine HEIDELBERG Speedmaster SM 74-5 with ink Corona GA 5015 (Huber Group), and at screen printing machine TX-2530 with using stencil mesh with resolution 70 lines/cm. For printing images were used UV-fixing aroma varnish Incandensess with floral smell [3].

To detect changes in the intensity of release and storage odors from aroma prints were taken into account such factors as cooling to a temperature of -10 °C, heated to 100 °C in an incubator, and exposed to direct ultraviolet light (sunshine). For the experiment a group of people with 9 persons were handed out cardboard strips pre-coated with aroma varnish that proposed rate the change of odor intensity on a 10-point scale at regular intervals (every 6 hours).

Thin slices of fragranced images were examined in the light microscope Biolam with lens's magnification x90, the photographs were taken with using a special set-top box for SLR digital camera Olympus E520 with image resolution of 10 megapixels with next image framing to the size 800x600 pixels to separate of microcapsules with fragrances for some shots. The study of the structural changes of cardboard flavored with aroma printed lacquer was performed in transmission electron microscope SELMI PEM-100-01 using ultrathin sections and in the scanning electron microscope JEOL T220A (Japan). Image surface samples were obtained at magnifications x2000 [1,6].

Results and discussion

Results of analysis the impact of cooling, heating and UV light on the change of images' fragrances, conducted with the assistance of experts, are given in Table 1.

Table 1

The influence of external factors on the change in intensity of odor flavored image

Recipients	External Factors								
	Heating			Cooling			UV light		
	Duration (h)			Duration (h)			Duration (h)		
1	2	4	6	2	4	6	2	4	6
2	9	10	9	8	7	9	10	10	9
3	8	10	9	9	7	8	10	10	10
4	9	9	9	9	8	9	9	9	10
5	8	10	9	8	7	8	10	9	9
6	10	10	10	8	8	8	10	9	9
7	8	9	8	10	8	9	9	10	9
8	8	10	8	8	7	8	10	9	9
9	8	10	9	9	8	8	10	10	10

Electron - microscopic researches of fragranced images formed by offset printing, after conducting experiments (Fig.1b) showed significant changes in the structure of aroma leyer than just the printed image (Fig. 1).

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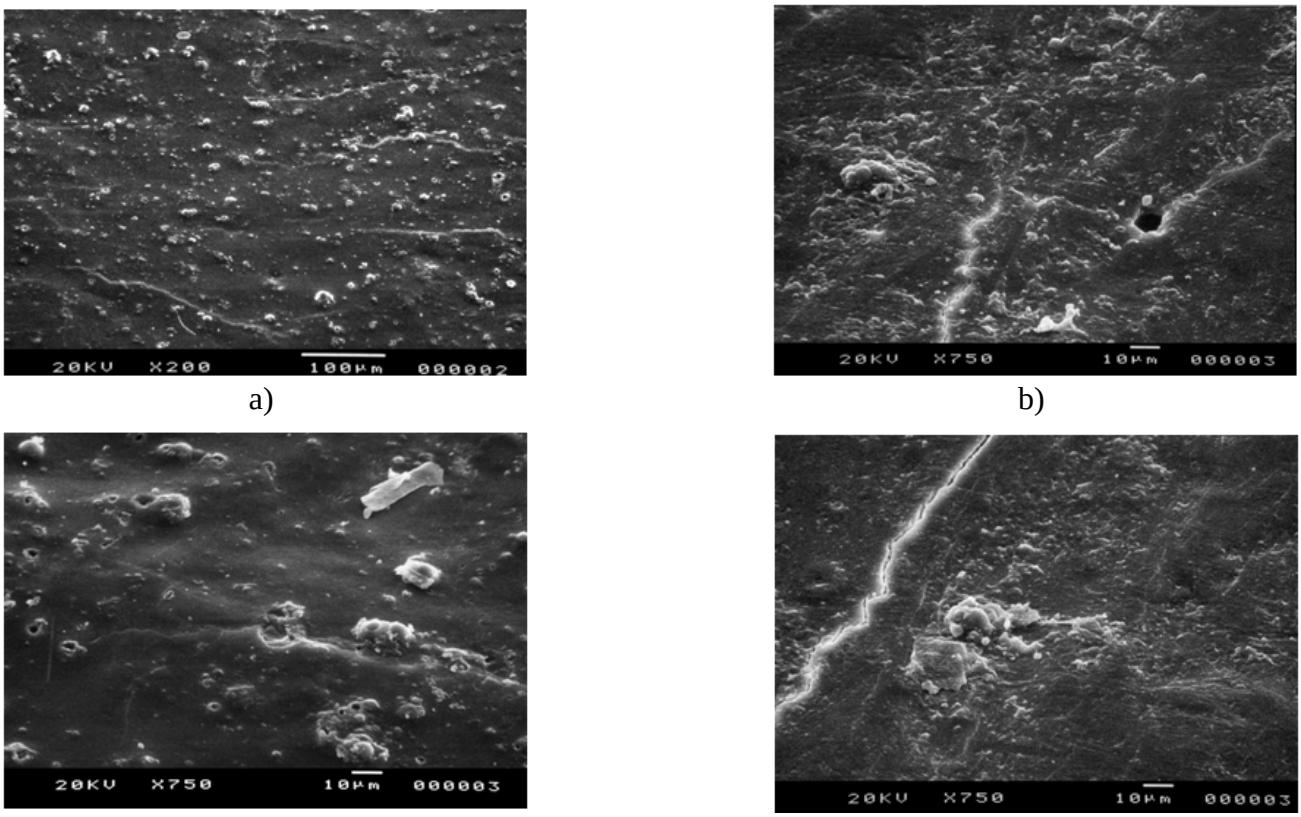
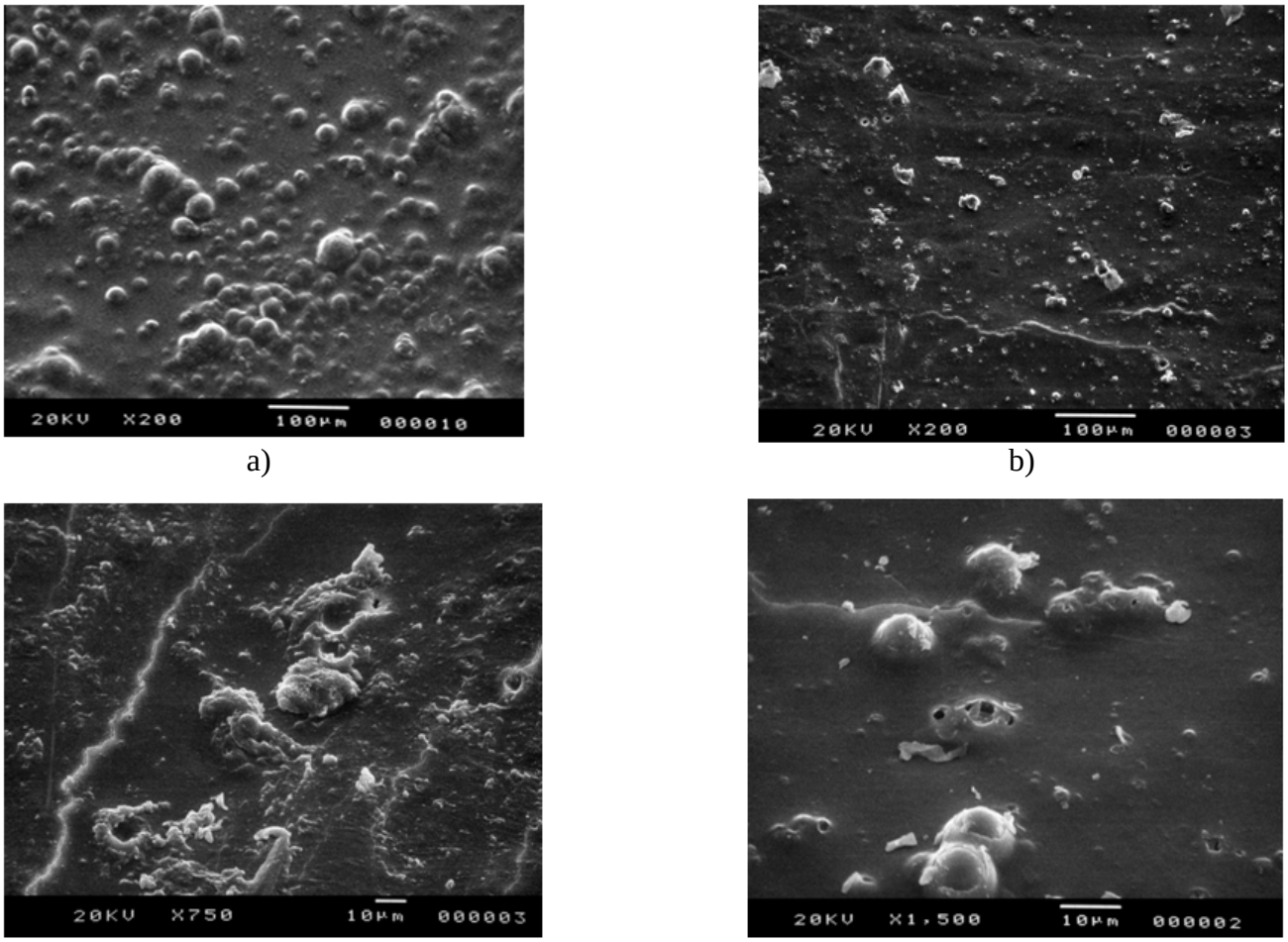


Fig. 1. *Microstructure of fragranced images formed by offset printing*
a) just printed image, b) image after expluatatin,
c) image after 6 months, d) image after 1.5 years



a) b)

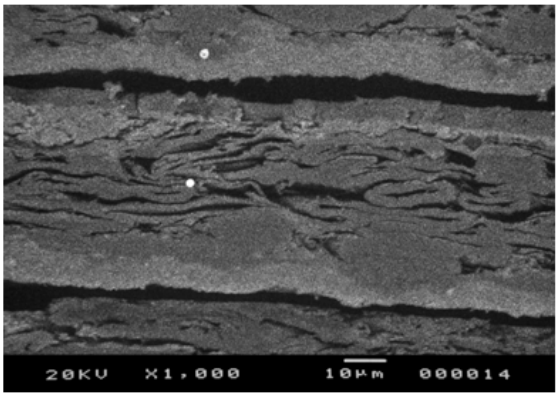
c) d)

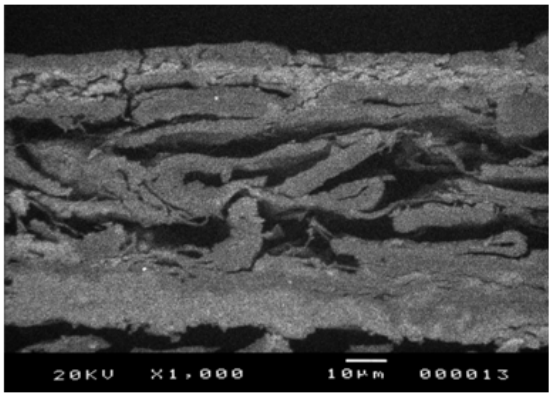
Fig. 2. *Microstructure of fragranced images formed by screen printing*
a) just printed image, b) image after expluatatin,
c) image after 6 months, d) image after 1.5 years

Conducting the repeated experiments after 6 months (rys.1c, 2c) showed no significant changes in the intensity of odor samples. However, analysis of the micrographs showed considerable damage of microcapsules in the structure of fragranced images, including printed by screen printing with greater thickness of the varnish layer.

Expert studies mentioned above samples after 1.5 years (rys.1d, 2d) showed a significant reduction in the intensity of fragrance. This fact can obviously be explained that due to the release of fragrance by "Rub and Smell" held microcapsules destruction that resulted unauthorized weathering smell for a long period. This is confirmed by the microphotographs shown in Fig.1 and Fig.2.

By using scanning electron microscopy confirmed the penetration of UV varnishes in the structure of the test board (Fig. 3 and Fig.4). When using varnishes high viscosity (up to 15-20 percent aroma capsule) no significant penetration to the structure of cardboard as in offset and screen-printing method (Fig. 3 a, b)

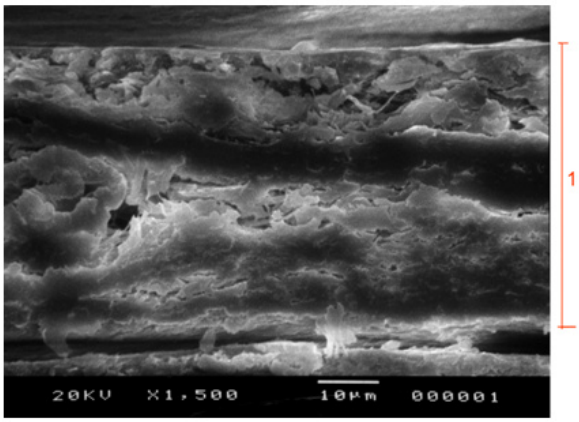


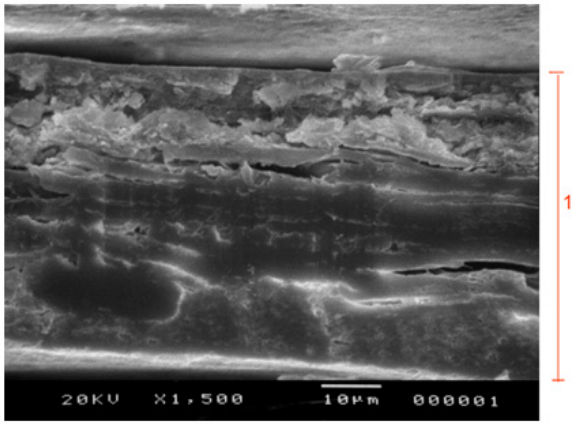


a) *b)*

Fig. 3. *Microstructure cardboard surface with UV aroma varnish high-viscosity: a) offset printing, b-screen printing*

Reduced viscosity of varnish (and corresponding decrease to 5-10 percent aroma capsule within it) leads to its deep penetration into the structure of the board, which is a negative point, clearly show micrographs (Fig. 4)





a) *b)*

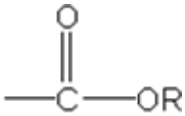
Fig. 4. *Microstructure of cardboard coated with UV aroma varnish low viscosity: a) offset printing b) screen printing*

Known that anti penetration varnish coatings that cover or fill the surface pores of cardboard, in particular the Cretaceous layer. Investigations confirmed that paperboard coating is ideal for use aroma printing using UV varnishes, especially with high viscosity. UV-aroma varnish after complete formation of polymer networks, "linking macromolecules polish" aesthetic effect and provide good operating conditions.

The cooling, heating and UV-light have no effect on the change of fragrance saturation, because it destroys the structure of microcapsules with aromatic substances that are part of offset printing varnish. However, a significant impact on the change of intensity of fragrance is efficiency image, the total number of consumers who use these products and shelf life.

Unfortunately, the only theory that could explain the stability of fragrances at those or any other conditions of use, all currently does not exist. Famous hypothesis Dyson (1937), in which he explains the percentage release of fragrance based on vibration hypothesis perception of smell by life organisms. Noteworthy method based on quantum theory, known in the literature as - Raman–effect that investigated molecular vibrations of odorous substances. In addition, references indicative of other approaches to the evaluation of fragrance [3]. Any distribution of substances by smell based on

our subjective feelings, often what like one, not like the other. It is not possible to objectively evaluate and express odor substances yet. It's usually compared with anything, for example with the smell of violets, orange, roses. Science has gathered a lot of empirical data that is associated odor with the structure of molecules. Some sources cite examples to 50 or more such combinations between structure and odor. Indisputable is the fact that the aromatic substances usually contain one of the so-called functional groups:

carbine -C-OH, carbonyl> C = O, ester and  others.

At first opinion it might seem that the more functional groups in the molecule lead to the better or more it smells. Often it is the opposite. For fatty connections (they contain chains of carbon atoms) layers of different groups reduces odor. Increasing number of identical groups eliminates odor in aromatic substances of all classes.

Great influence on the odor has molecule size. Typically, such compounds, that belonging to the same homologous series, smell the same, but the strength of smell decreases with increasing number of atoms; connections with 17-18 carbon atoms usually odorless. Fragrance of cyclic compounds depends on the number of rings. If they are 5-6, substance smells bitter almonds or menthol, 6-9 - provides transitional smell, 9-12 - the smell of camphor or mint, 13 - the smell of resin or cedar, 14-16 - the smell of musk or peach, 17 - 18 - smell of onions, connection with 18 members and more do not smell at all, or smell very little. The intensity of the fragrance depends also from the structure of the carbon chain. For example, branched-chain aldehydes smell more strongly and pleasantly, then isomeric aldehydes normal structure.

Great influence on the odor has substituents position in the molecule. The position of the double bond in the molecule also effects on the smell. Often unpleasant odor causes by triple bond. Obviously, more weight on smell has cycles, especially with 15 - 18 units.

Because of this such kind of research deserve attention, they are relevant and promising, since making new approaches in the theory of explaining mechanism of fragrance's release from different environments.

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