

## CFMA-LIKE APPLICATORS ALLOWING HEATING OF THE TUMOR SIMULTANEOUSLY WITH ITS EXTERNAL RADIATION

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### Purpose

The employed now equipment for simultaneous external radiation and hyperthermia (SERH) treatment for cancer requires complicated matching devices to combine the radiation and hyperthermia installations [1]. The main reasons for this situation are the rather bulky EM and US applicators. The aim of this work is the development of applicators which would exclude the necessity of additional devices to match the radiation and hyperthermia equipment.

### Materials and Methods

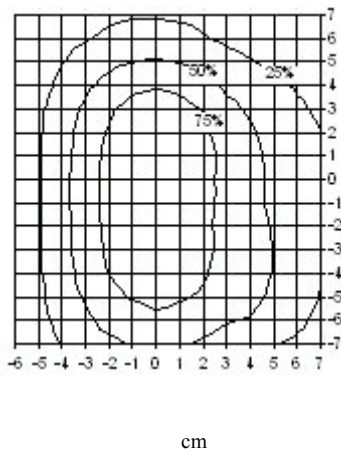
The successfully employed Contact Flexible Microstrip Applicators (CFMA) operating at the frequency of 434 MHz [2] were chosen as a prototype for the desired applicator. The main development task consisted in the design of new microstrip launching and matching circuits which would not introduce noticeably attenuation of  $\gamma$ -rays and could be matched with the irradiating microstrip antenna being loaded upon tissues with different dielectric properties. Relative SAR characteristics of the developed applicators were measured by means of a miniature dipole antenna at the depth of 1cm in a liquid muscle phantom (saline solution of 0.6%) poured in a plexy-glass tank with dimensions  $(45 \times 30 \times 12) \text{cm}^3$ .

### Results

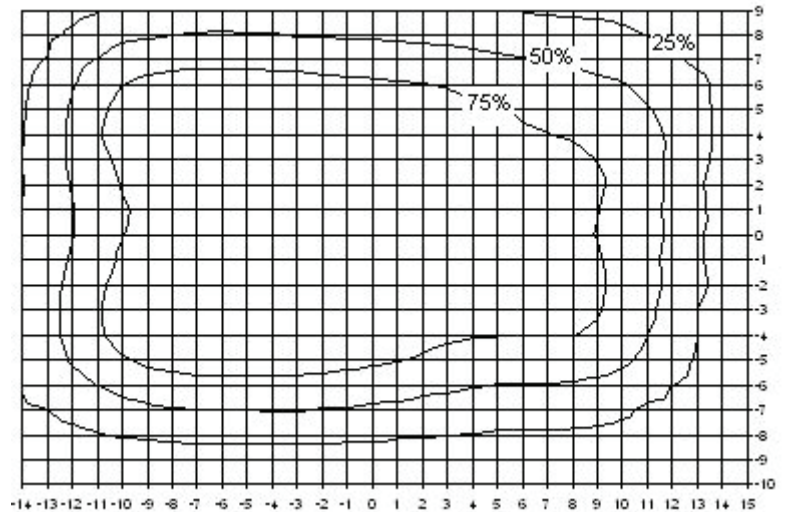
There were developed four types of radio-resistant contact flexible microstrip applicators: CFMA-SRH-2, -3, -4, -5. They are suited for simultaneous radiation and hyperthermia, whereas their design is analogous to that of common CFMA types: all of them have an integrated water bolus, the weight of the largest of them (CFMA-SRH-3) is less than 0.750 kg, the allowable operating microwave power for all four applicator types is up to 250 W. Absorption characteristics of the CFMA-SRH applicators allow the  $\gamma$ -rays penetrate the whole applicator aperture with a minor and uniform attenuation [3]. The table below describes the operating characteristics of the applicators, and Figs.1 and 2 present, for example, the relative SAR distribution over the apertures of applicators CFMA-SRH-2 and 5. The suppleness of the applicators allow their bending over cylindrical or semi cylindrical parts of the human body, thus providing the possibility of achieving a noticeable focusing effect.

Parameters of inductive CFMA-SRH applicators operating at the frequency of 434 MHz.

CFMA applicator type	Aperture size(AS) (cm)	EFS (cm)	EFS to AS ratio	Weight (kg)
SRH-2	14 x 15	9 x 13	0.56	0.300
SRH-3	20 x 29	16 x 23	0.63	0.700
SRH-4	19 x 20	15 x 16	0.63	0.450
SRH-5	20 x 29	15 x 24	0.62	0.700



a)



b)

cm

Relative SAR distribution:

a) CFMA-SRH-2. b) CFMA-SRH-5

### Conclusion

There are developed four types of effective contact flexible microstrip applicators allowing  $\gamma$ -rays pass through the applicator with negligible intensity losses. Thus, they are applicable for simultaneous radiation and hyperthermia treatments. It is important that they offer the main advantageous features of the common CFMA applicators: light weight (0.3--0.75kg), flexibility, good matching with the heated tissues, rather high SAR distribution homogeneity, and a wide range of EFS sizes (100—400)cm<sup>2</sup>.

### References:

1. Moros, E.G., et al., 1995, IJH, v.11, 11-26
2. Gelvich, E.A., Mazokhin, V.N., IEEE Trans.BME, 2002, v.49, 1015-23
3. Gelvich, E.A., Kramer-Ageyev, E.A., et al., This Meeting.

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