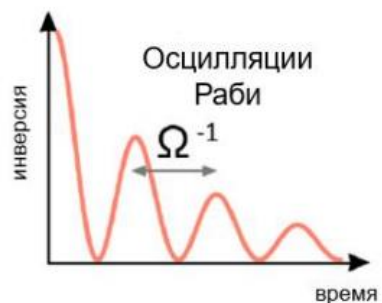


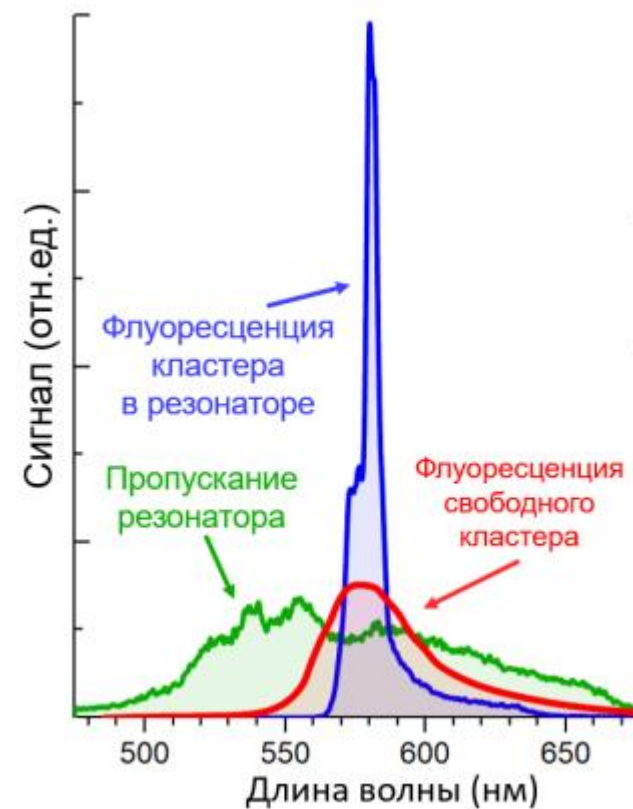
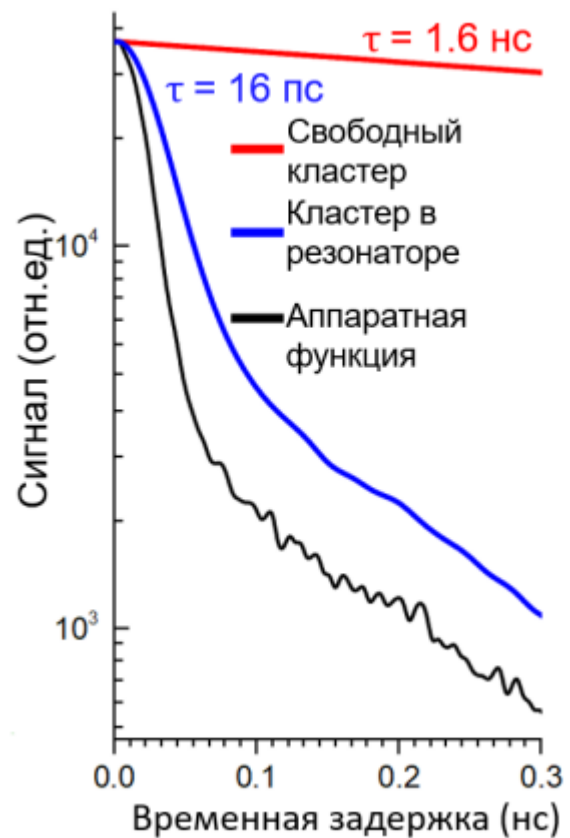
Исследование Фёрстеровского
механизма переноса энергии
между молекулами в
волноводе нулевой моды

Квантовая инженерия

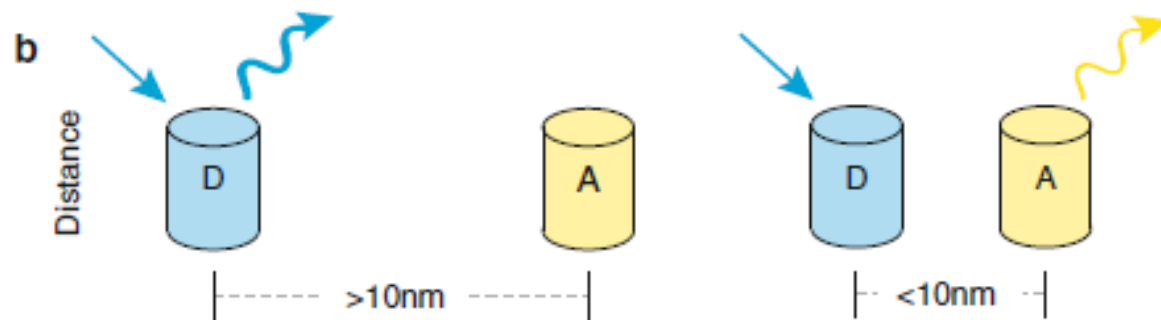
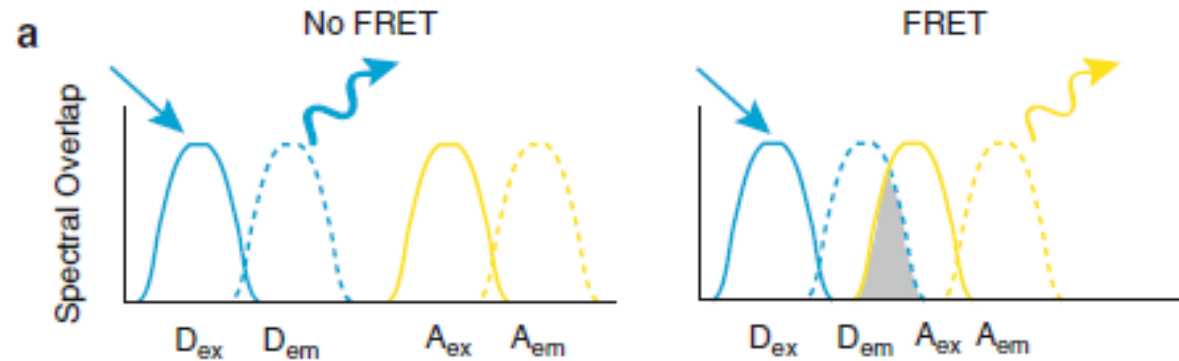
Сильная оптическая связь



Эффект Парселла

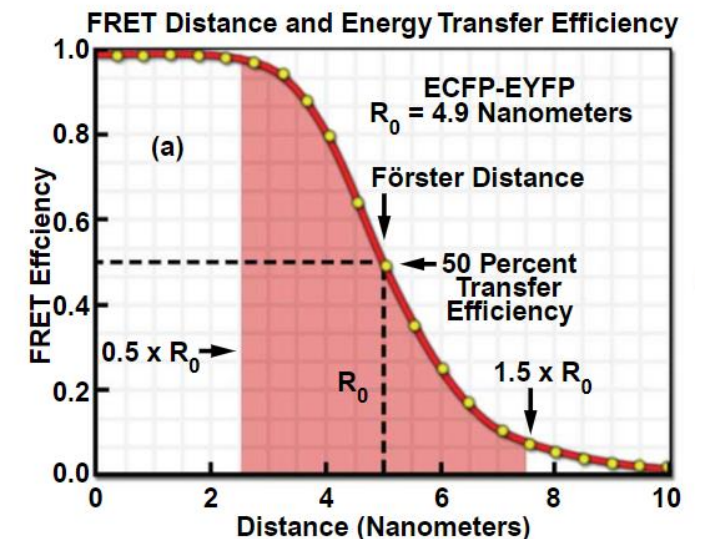
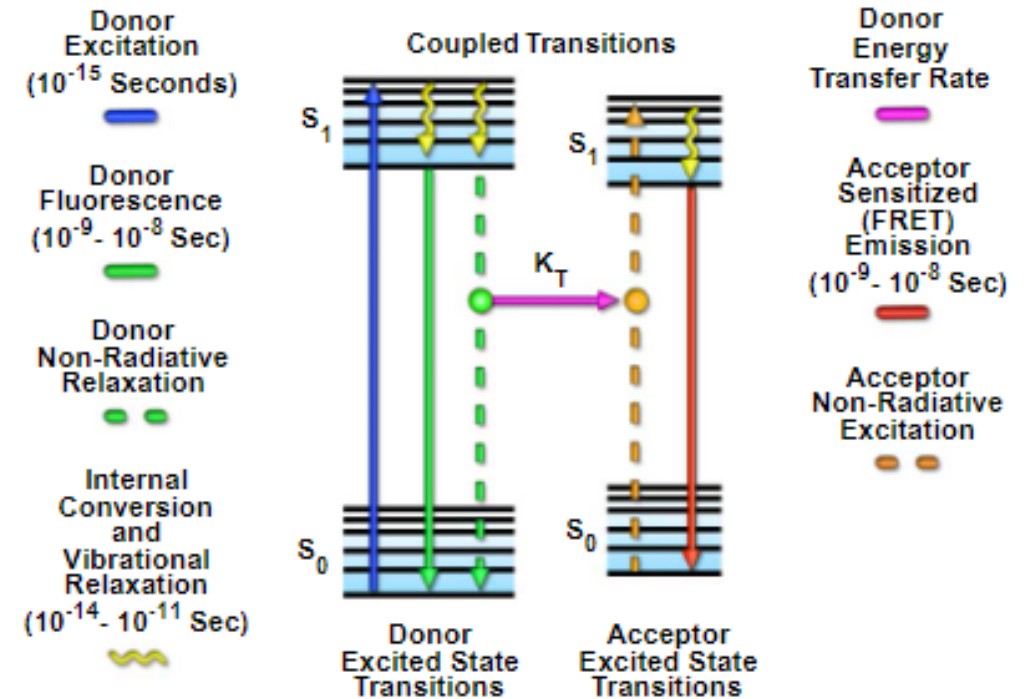


Förster resonance energy transfer



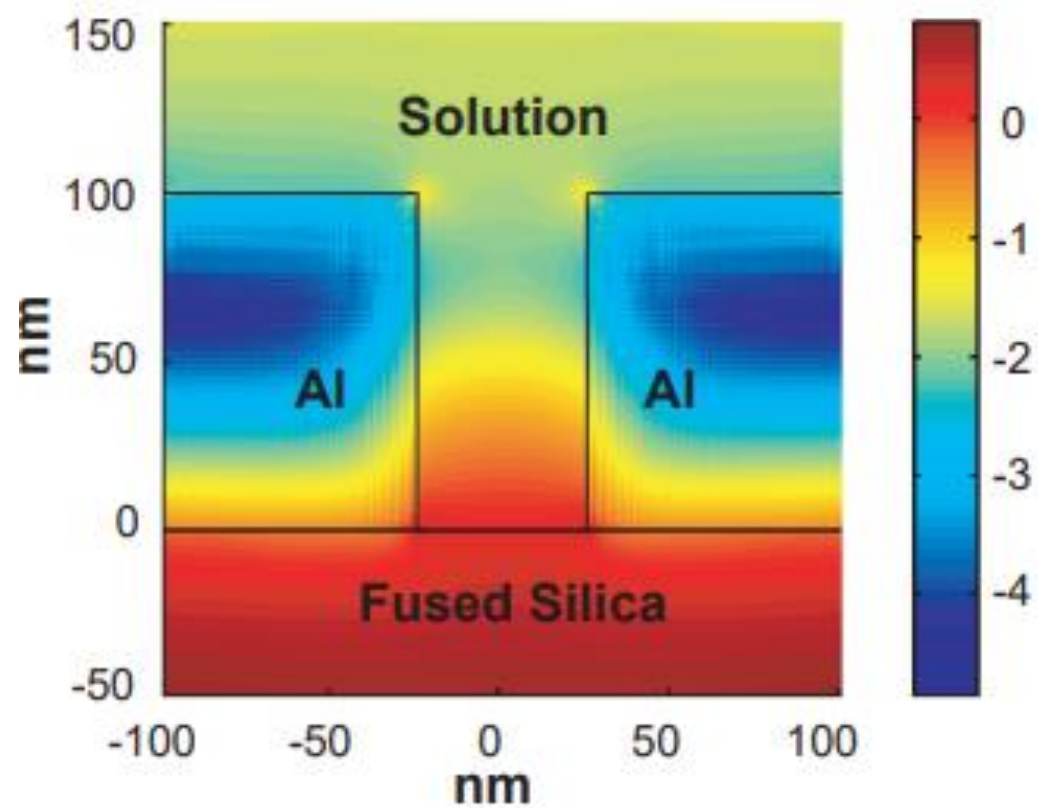
$$R_0 \sim \left(\frac{K^2 \times Q_D \times J(\lambda)}{n^4} \right)^{1/6}$$

$$E_{FRET} = \frac{1}{1 + \left(\frac{r}{R_0} \right)^6}$$



Zero-mode waveguides

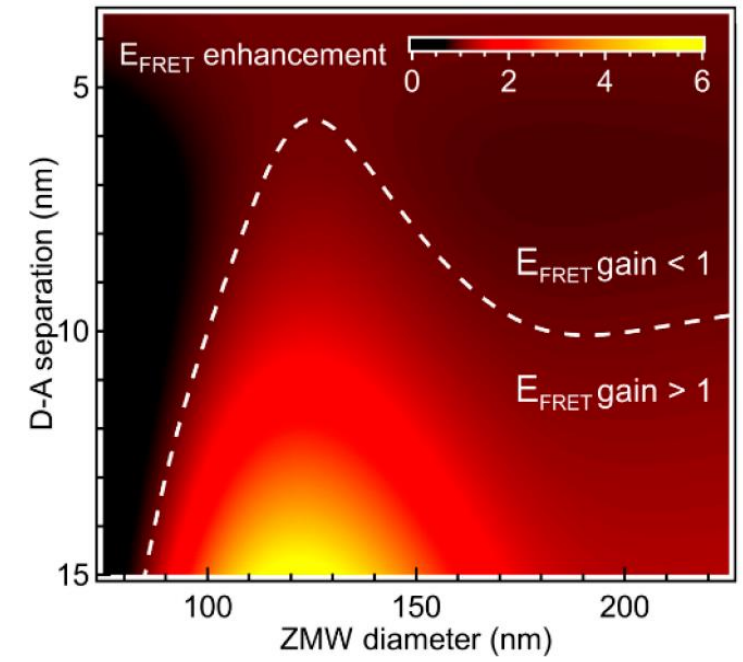
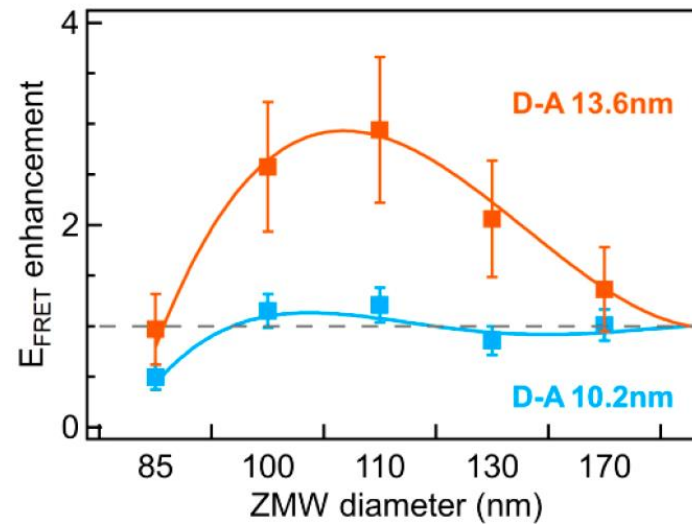
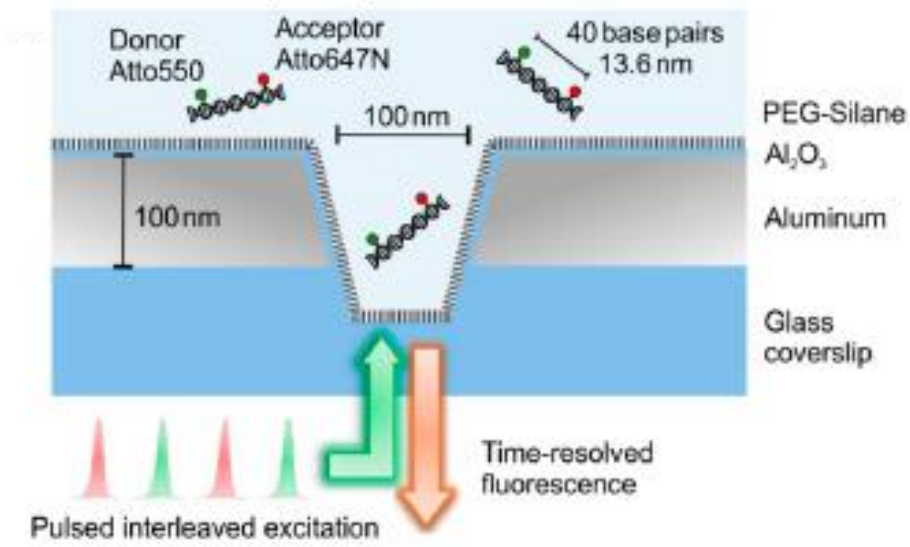
$$V_{eff} \approx 10^{15} \text{cm}^3$$



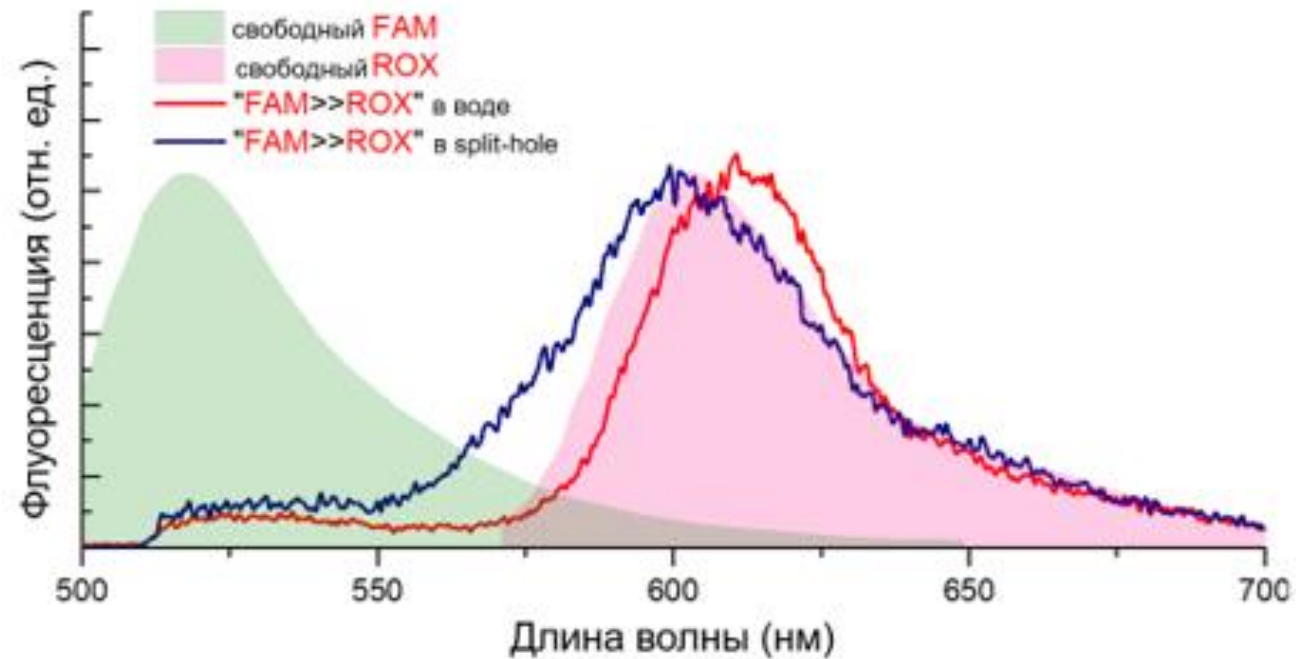
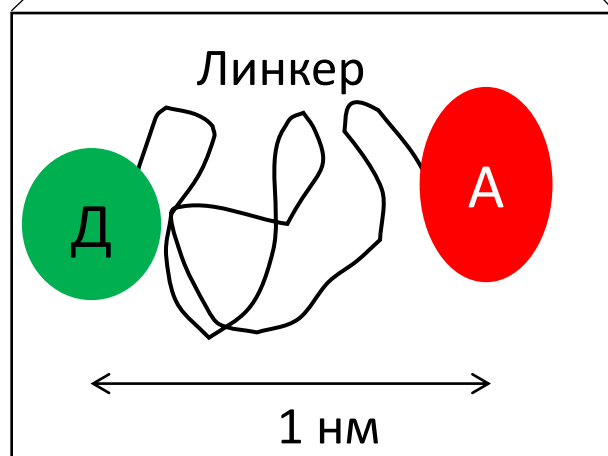
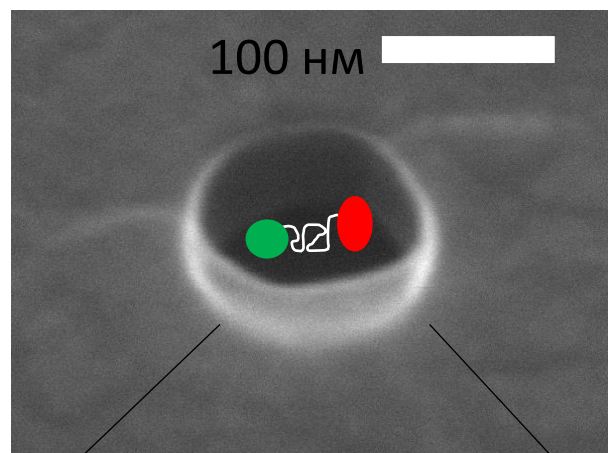
Extending Single-Molecule Förster Resonance Energy Transfer (FRET) Range beyond 10 Nanometers in Zero-Mode Waveguides

Mikhail Baibakov,[†] Satyajit Patra,[†] Jean-Benoît Claude, Antonin Moreau, Julien Lumeau, and Jérôme Wenger*[✉]

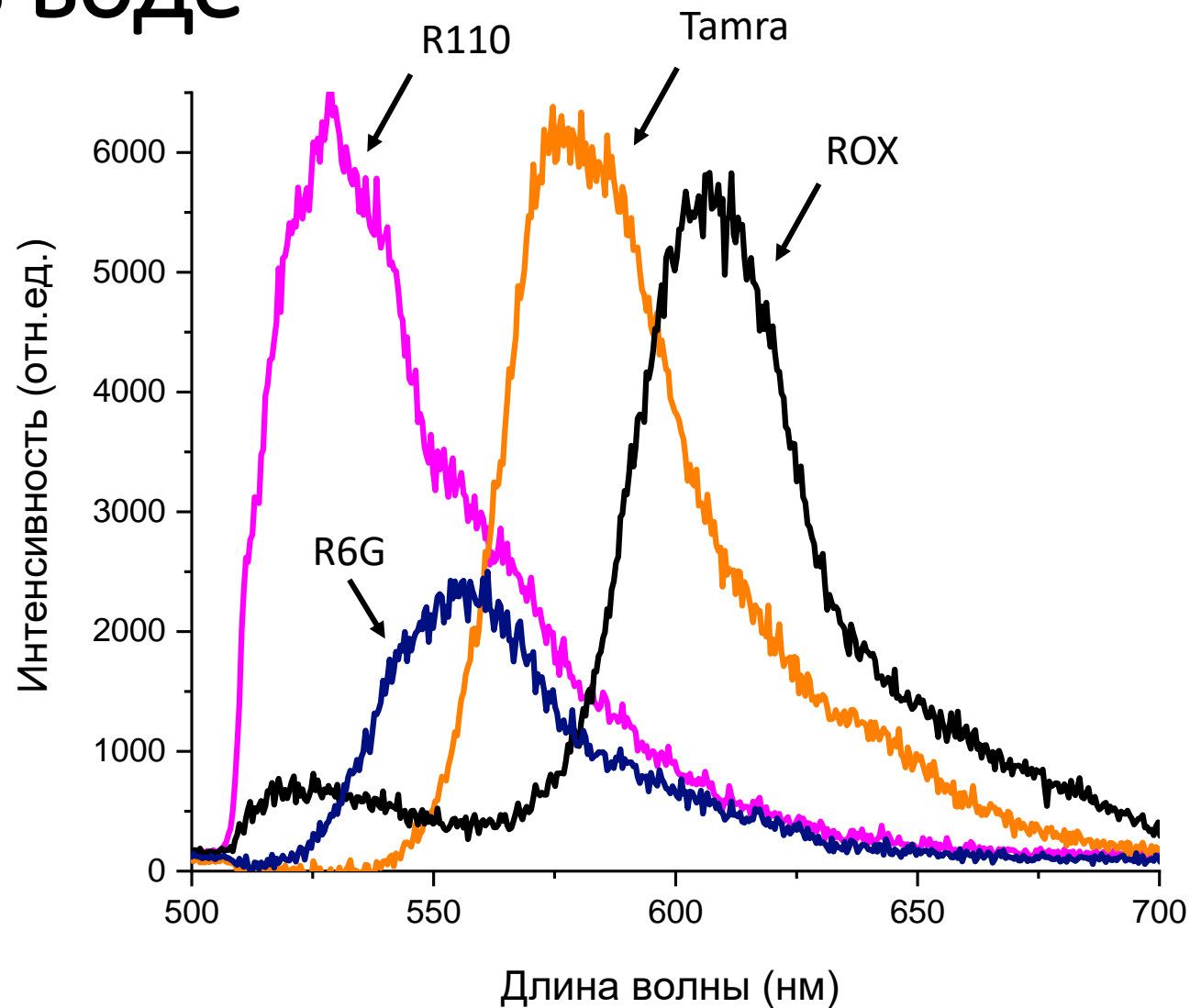
Aix Marseille Univ, CNRS, Centrale Marseille, Institut Fresnel, 13013 Marseille, France



Объект исследования



Спектры флуоресценции кассетных красителей в воде



$$QY_{FAM} = 0.93$$

$$QY_{ROX} = 1$$

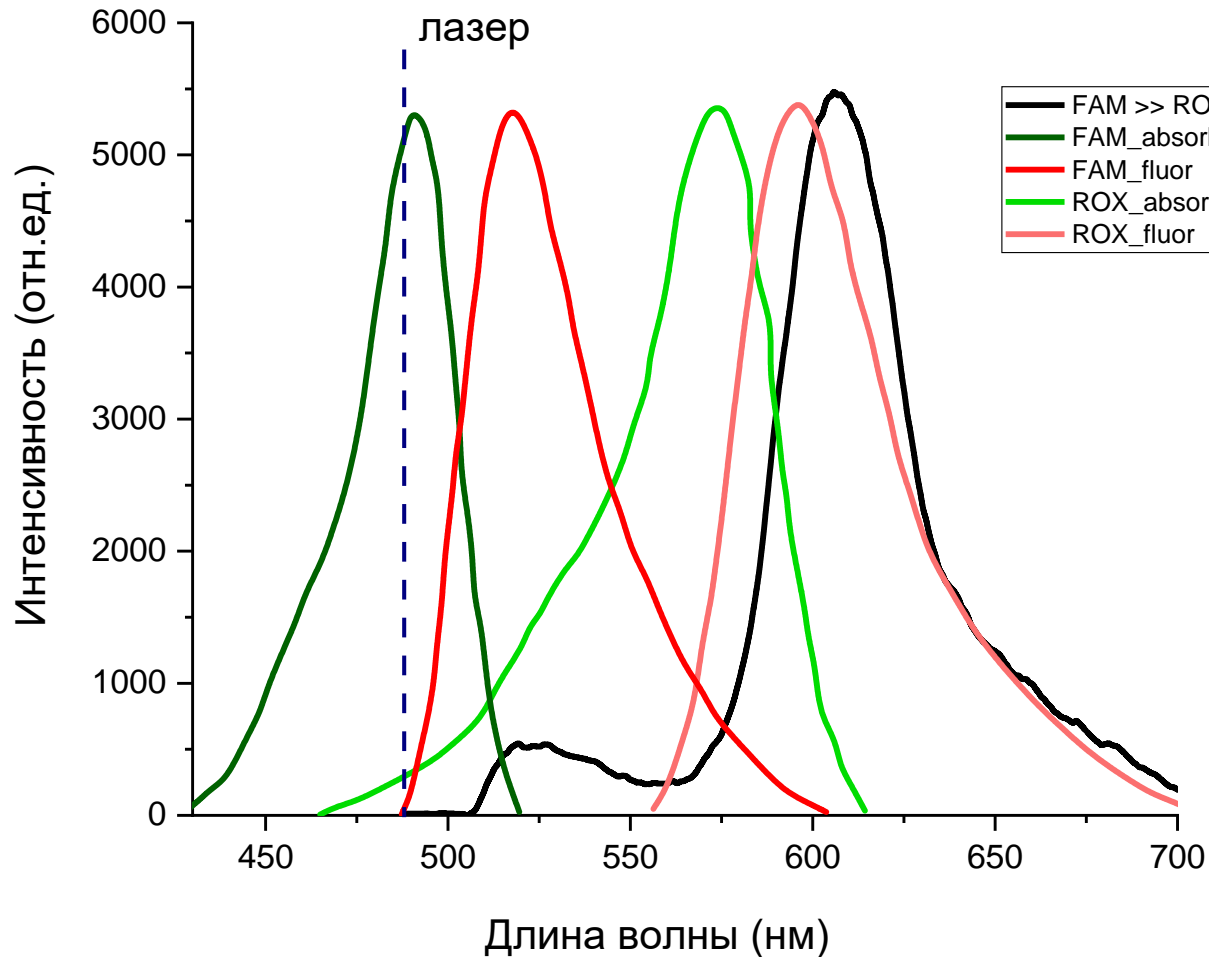
$$QY_{Tamra} = 0.1$$

$$QY_{R6G} = 0.95$$

$$QY_{R110} = 0.9$$

$$I_{laser} \sim 1 \text{ кВт/см}^2$$

Спектры поглощения и флуоресценции красителей FAM и ROX



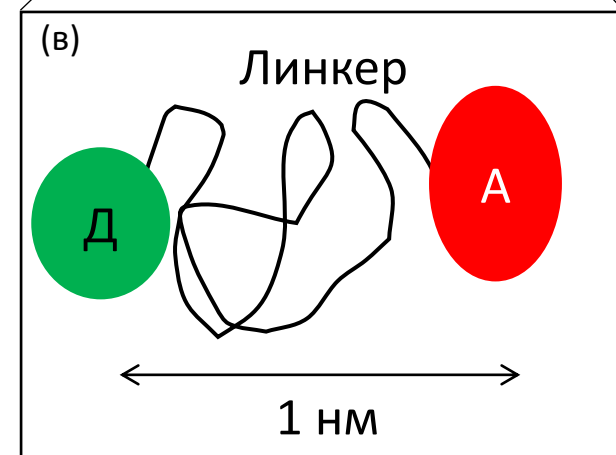
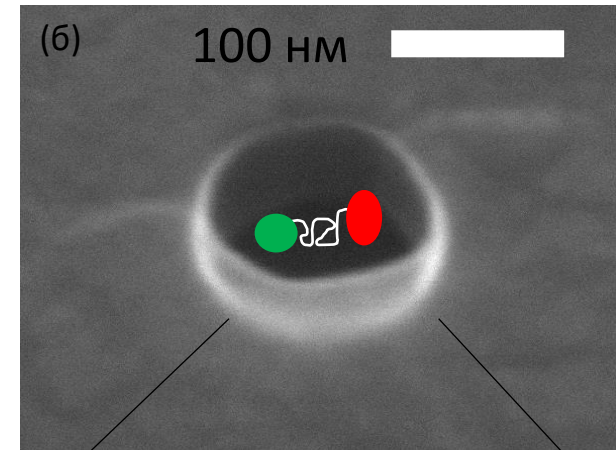
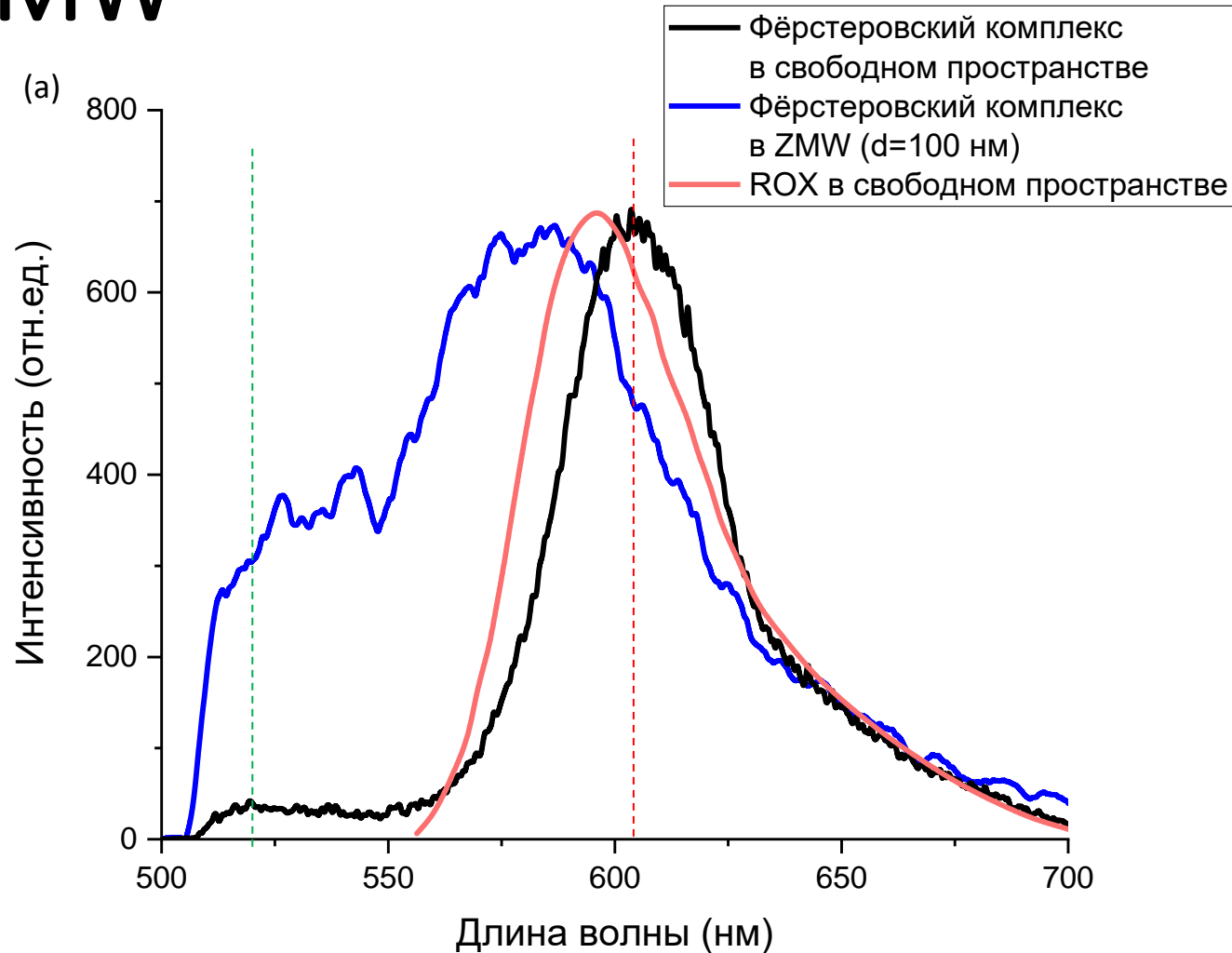
$$R_0 \sim \left(\frac{K^2 \times Q_D \times J(\lambda)}{n^4} \right)^{1/6}$$

$K^2 = \frac{2}{3}$
 $QY_{FAM} = 0.93$
 $J(\lambda) = 0,49$
 $n = 1,333$

$$E_{FRET} \approx 92\%$$

$$R_0 \approx 1,5 \text{ нм}$$

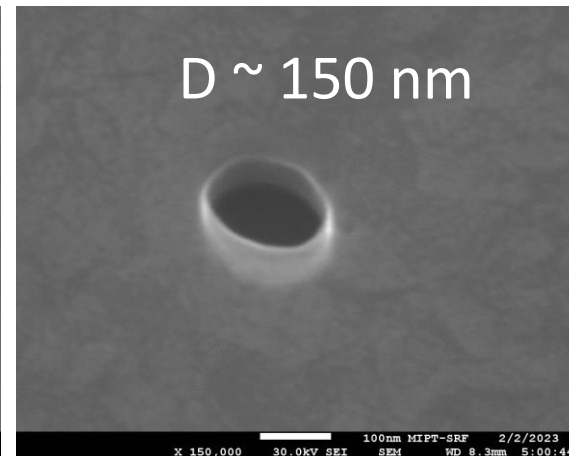
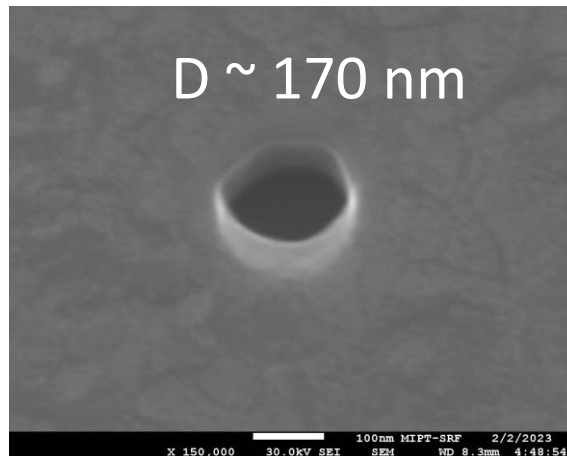
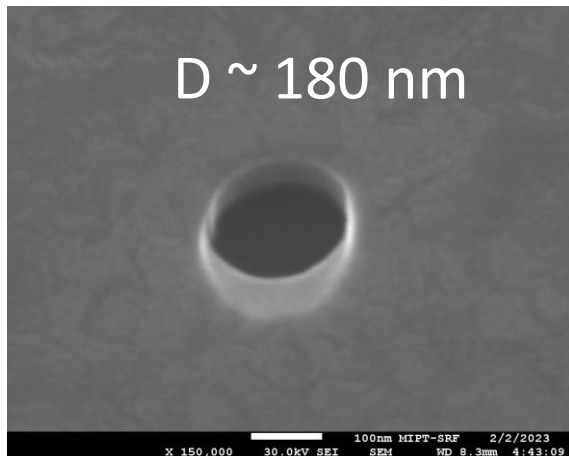
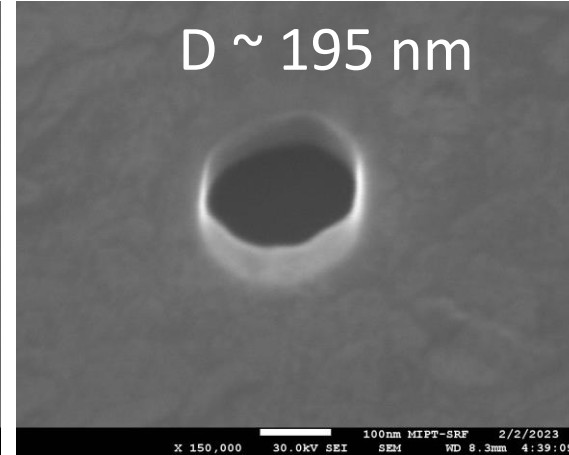
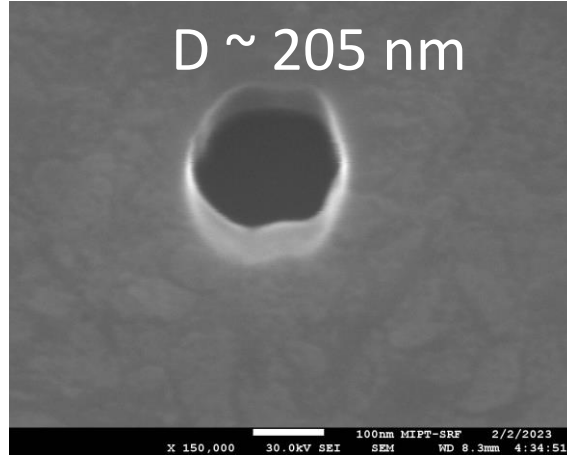
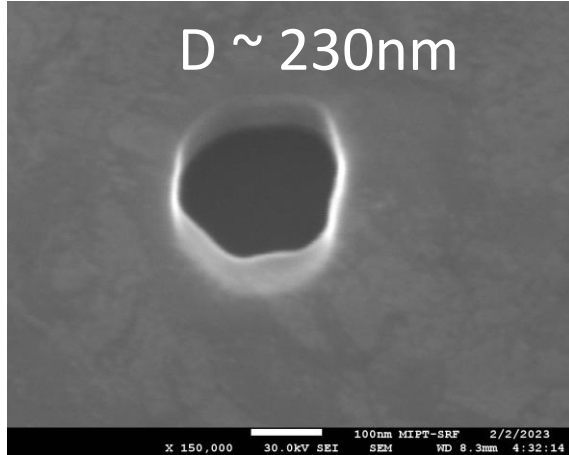
Исследование пары красителей FAM-ROX в ZMW



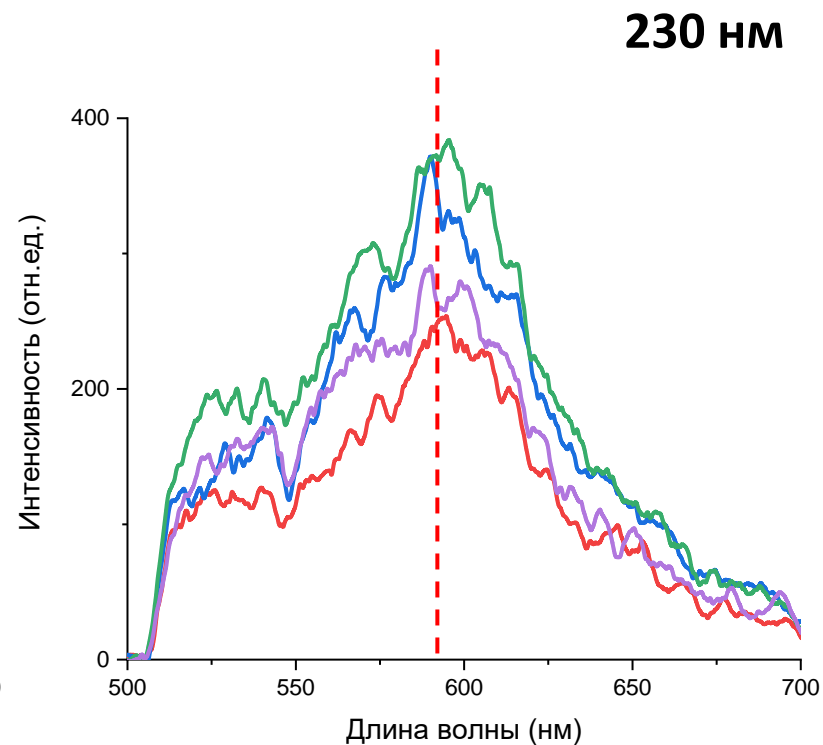
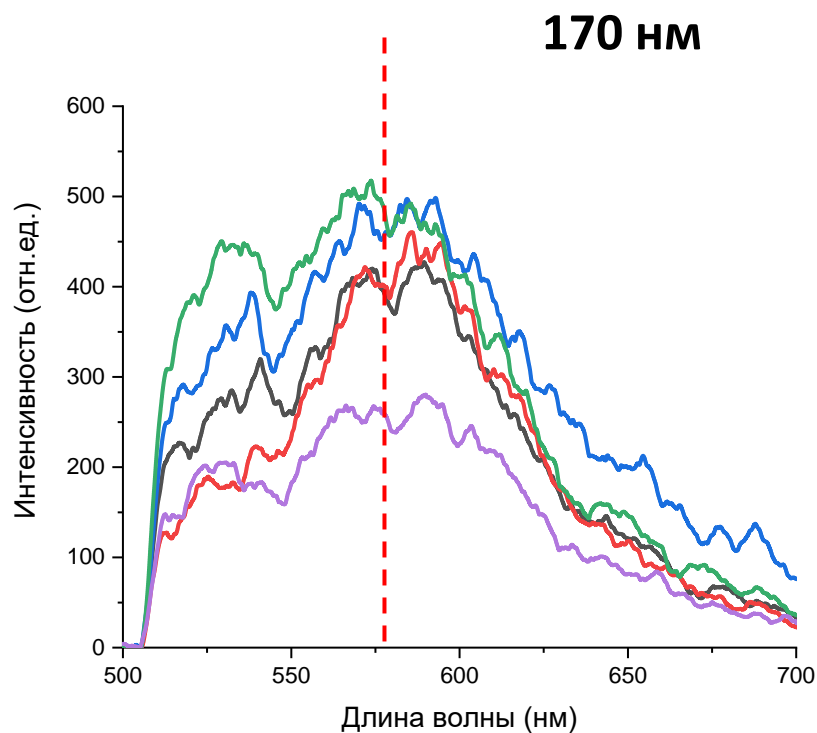
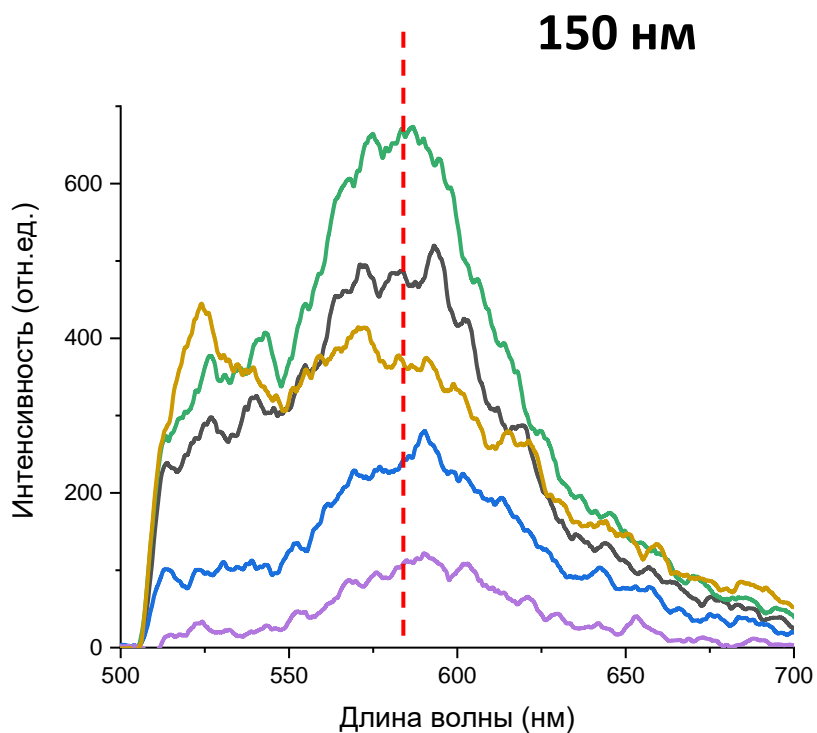
$$I_{\text{laser}} \sim 0,5 \text{ кВт/см}^2$$

$$n \approx 10^{15} \text{ шт/см}^3$$

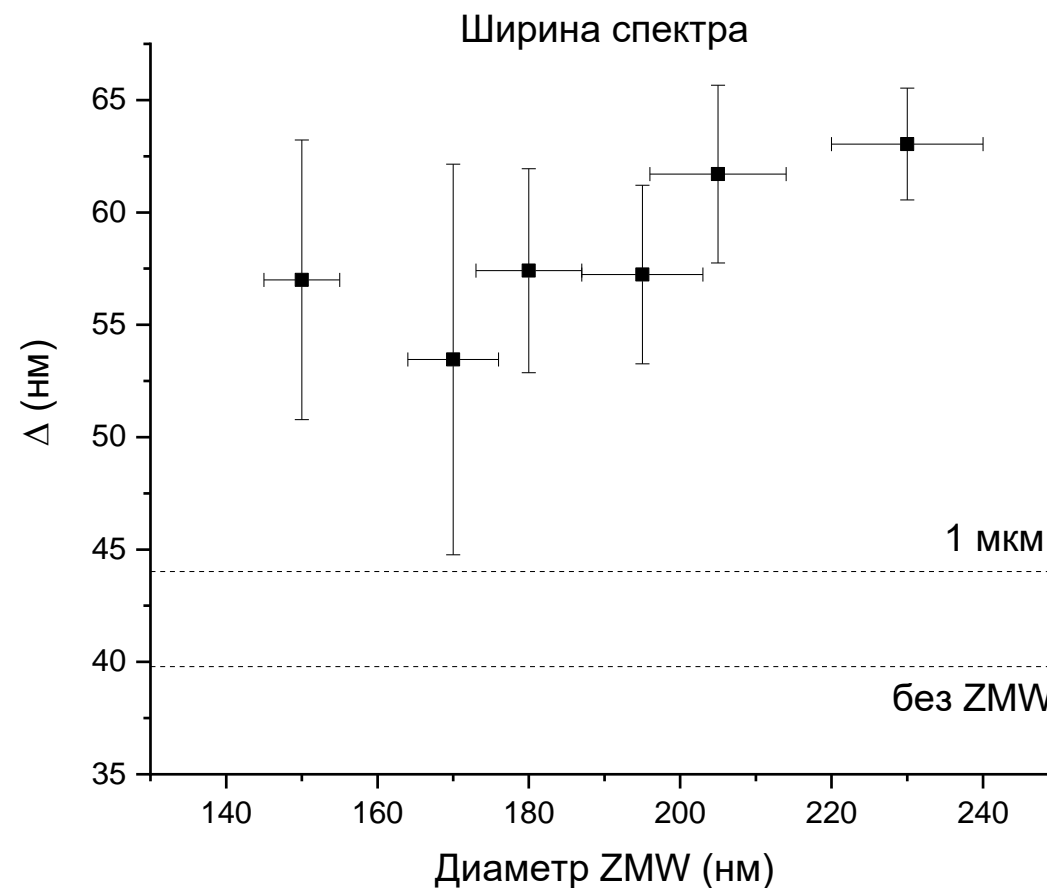
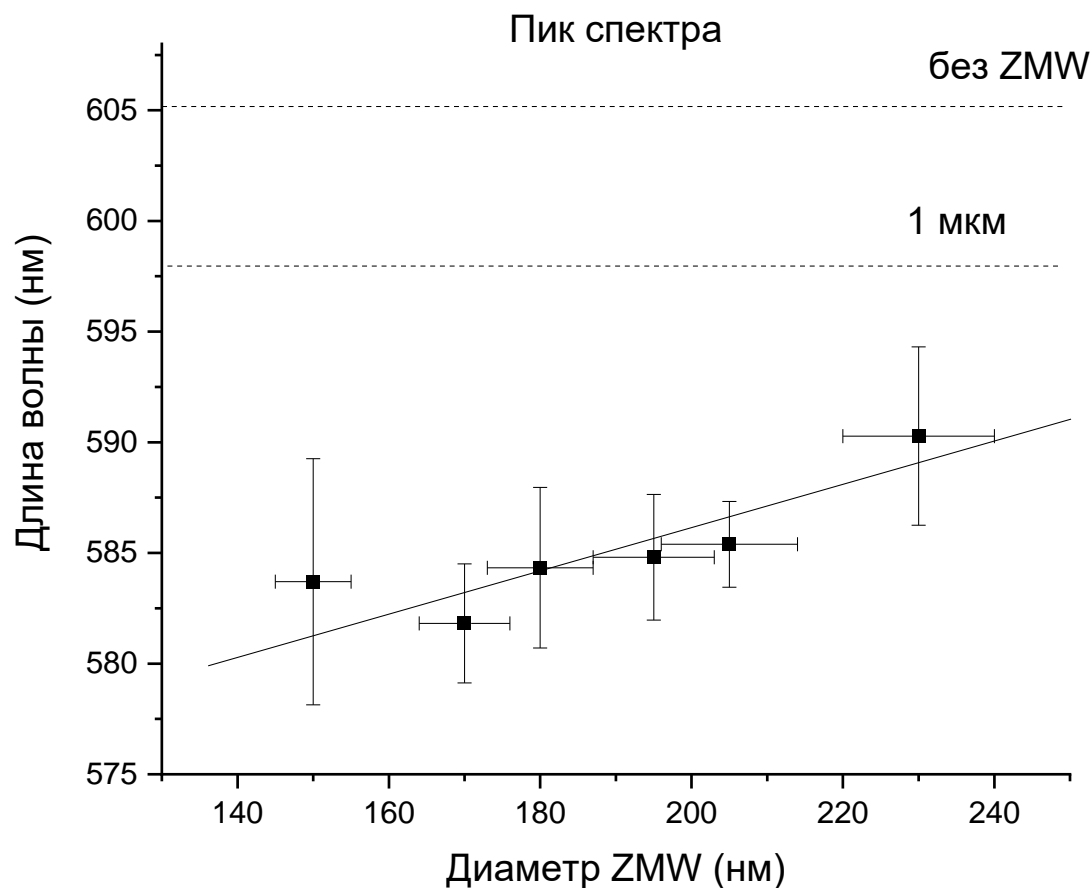
СЭМ-фотографии ZMW



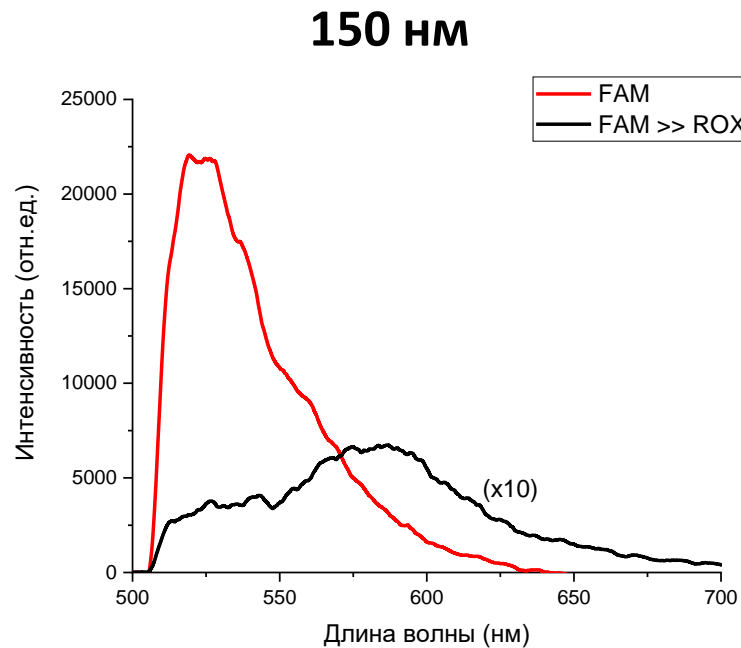
Влияние ZMW на спектры флуоресценции кассетных красителей



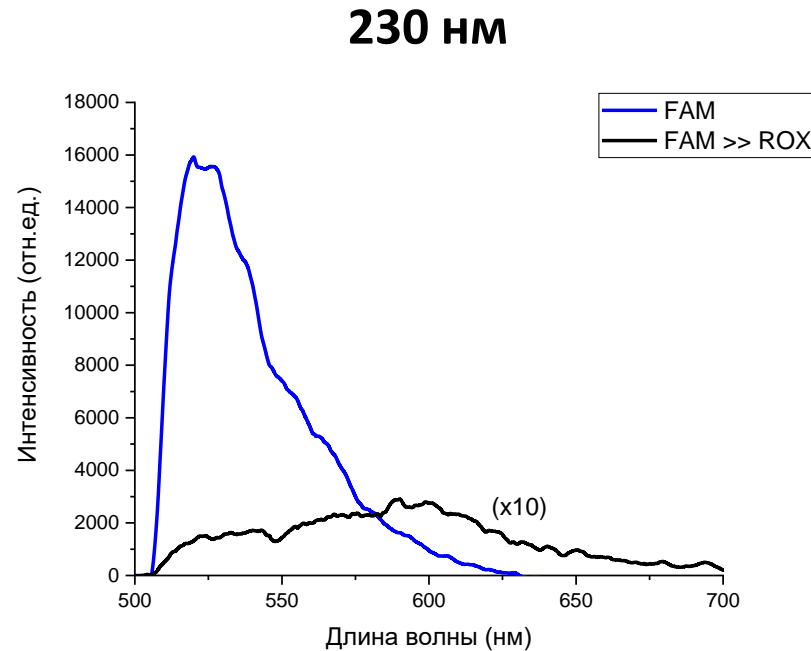
Влияние диаметра ZMW на спектральные характеристики флуоресценции акцептора



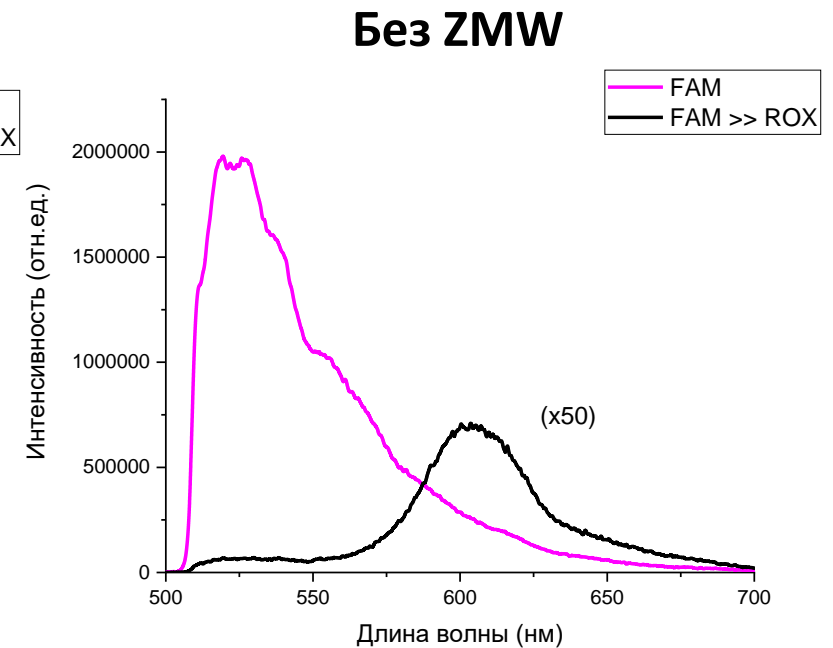
Влияние диаметра ZMW на эффективность FRET



$$\frac{I_{ROX}}{I_{FAM}^0} = 0,04$$



$$\frac{I_{ROX}}{I_{FAM}^0} = 0,03$$



$$\frac{I_{ROX}}{I_{FAM}^0} = 0,007$$