arises primarily from the sensitivity of Frank loop formation, interaction and unfaulting to dpa rate. The primary requirement to attain steady-state swelling is the resultant formation of a mobile dislocation network. The addition of carbon suppresses the flux sensitivity, however, and the microstructural origins of this response are currently under investigation.

The second experiment involves nickel ion irradiation of Fe-15Cr-16Ni only, but at three temperatures, 300, 400, 500°C, and three dpa rates between $1 \times 10^{-4}$ ınd $1 \times 10^{-3}$ dpa/sec.

At these higher dpa rates the transient regime is longer than that observed in the neutron irradiation experiment, and increases further as the dpa rate increases. Once again the most important results are the sensitivity of Frank loop behavior to dpa rate, and the decrease of swelling at every tested temperature as the dpa rate increases.

The implications of these findings on the interpretation of other experiments conducted on neutron-irradiated commercial alloys will be discussed. In general these latter studies also show that swelling decreases as the dpa rate increases, primarily due to an extension of the duration of the transient regime.

## Радиационно-стимулированная аморфизация: сравнение материалов и методов воздействия

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В работе делается попытка аналитического сравнительного обзора экспериментальных результатов и теоретических представлений о процессах аморфизации в полупроводниковых материалах (моноатомных и многокомпонентных) и металлах. Рассматриваются следующие проблемы:

1. Можно ли получить аморфизацию при облучении:
   - быстрыми электронами;
   - протонами;
   - нейтронами.
2. Разница в процессах аморфизации алмаза и кремния.
3. Существующие модели аморфизации для ионной бомбардировки кремния. Накопление критической концентрации дефектов: пространственное разделение междоузельных и вакансионных дефектов (либо за счет разной подвижности, либо за счет разделяющих агентов – границ раздела, силовых полей, геттеров и так далее).
4. Представления о механизмах аморфизации в металлах. Существует ли критическая концентрация дефектов?
5. Аморфное состояние и стекло. Процессы образования: радиационное воздействие, быстрое охлаждение расплавов, лазерный отжиг.
6. Фазовый переход монокристалл – аморфное состояние и обратно. Рассмотрение с позиций синергетики. Можно ли ожидать самоорганизации при таких переходах.

Предлагаемый доклад по большинству поставленных проблем не имеет однозначных ответов и ставит своей целью обращение внимания на совокупность известных экспериментальных результатов и подходов к их описанию. Делается попытка сравнения известных подходов к описанию между полупроводниковыми и металлическими материалами.

## Phase Transformations in Ion Irradiated NiTi Thin Films

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SMA thin films have an anomalously high strain energy storage output and large transformational strains which have stimulated a current interest for their use as active elements that require large force and displacement outputs. We have studied a novel processing technique using ion irradiation to develop a thin film micro- actuator. The main experimental approach has been to irradiate one side of martensitic TiNi thin film that has been pre-deformed in tension. With sufficient irradiation dose, the martensitic transformation can be suppressed in the beam-damaged layer, whose thickness can be on the order of half the film's thickness. During heating to austenite phase, only the un-modified martensite structure can recover and contract to its original length, and the differential strain between the damaged and unmodified layers causes the film to bend out of plane. The partial energy stored in the damaged layer by the prior heating transformation is available to deform the martensite on subsequent cooling, which thus causes an uncurling of the film and thereby creates a two-way motion during thermal cycling.

Grummon et al [4] noted the dependence of the TiNi film's thermomechanical properties (after a 5 MeV $Ni^{2+}$ ion irradiation) with the irradiation fluence, and they also observed an unusual and unpredictable motion in the samples irradiated with a low fluence ($1 \times 10^{13}$ ions/cm$^2$). In a similar study by LaGrange et al [3], they observed monoclinic and BCC nanocrystallites surrounded by an amorphous matrix in this damaged layer with an irradiation temperature of 30°C. Barbu et al. have performed ion irradiations in electron stopping regimes and concluded that martensite has undergone transformation to amorphous and austenite phase in the tracks[3]. We have explored the electron stopping effects using 350 MeV Au ions. Amorphous and crystalline phase transformations were observed within the tracks and due to the electron excitations by HRTEM, and in addition, BCC TiNi phase nanocrystalline particles were observed, which were surrounded by an amorphous matrix within the track. The deformed $1 \times 10^{12}$ ion/cm$^2$ diffraction spectrum and microstructure was very different as compared to the undeformed $1 \times 10^{12}$ ion/cm$^2$. Thus, there was an effect of the predeformation on irradiation effects, which has not been previously observed. Whether this crystalline