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Photoelectric emission from gas solids

Electron photoemission from rare gas solids (RGS) is obtained using VUV open discharge sources. Temperature dependencies of the photoyield are measured by recording the ECR absorption of free electrons emitted from the RGS surfaces.

Key words: photoemission, solid gas, free electrons

Ю. А. Дмитриев

Фотоэлектрические выбросы от газовых тел

Фотоэмиссии электронов из редких твердых газов (РГО) получают, используя ВУФ источников открытого разряда. Температурные зависимости от поля измеряются путем записи поглощения ECR свободных электронов, испускаемых с поверхности RGS.

Ключевые слова: фотоэмиссия, твердый газ, свободные электроны

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Газдық денелерден фотоэлектрлік шығарылулар

Сирек қатты газдардан электрондардың фотоэмиссиясын ВУК ашық разрядты көздерін пайдаланып алады. Өрістен температуралық тәуелділіктер RGS бетінен шығарылатын ECR еркін электрондардың жұтылу жазбалары өлшенеді.

Түйін сөздер: фотоэмиссия, қатты газ, еркін электрондар.

Electron photoemission from rare gas solids (RGS) is obtained using VUV open discharge sources. Temperature dependencies of the photoyield are measured by recording the ECR absorption of free electrons emitted from the RGS surfaces.

Study of the electron emission property of solid Ne finds that the photoemission from pure Ne is governed by the surface processes. The effect is due to the exceptionally large path lengths of free excitons and CB electrons in the bulk. Comparative study of the temperature dependencies of the photoelectron yield in the «solid Ne – Ne discharge» and «solid Ne – He discharge» experiments revealed two different mechanisms, intrinsic and extrinsic, responsible for the electron emission in these experiments: escape of the electrons photoexcited into the conduction band, in the former one, and exciton assisted emission, in the latter one. The intrinsic emission from solid Ne shows no temperature dependence in the range 2–4.2 K, while the extrinsic one is temperature dependent: the photoyield is found to decrease with decreasing sample temperature.

Our studies show an effect which sample temperature has on the photoelectron yield in «solid Ar – He discharge» and «solid Kr – He discharge» experiments. The threshold energies for photoelectron emission, 13.9 eV and 11.9 eV, in pure Ar and Kr, respectively, are far below the photon energies of the most intense HeI VUV lines at 58.43 and 53.70 nm. Hence, intrinsic photoelectron emission takes place in these systems. The photoemission was found to be temperature dependent and sensitive to the trapping of CB-electrons in the bulk.

The present experiment with CO doping corroborates our previous finding that impurities with negative electron affinity, Ea(CO) = -1.8 eV, hamper the electron emission. An effect of a

dopant having large positive affinity on the yield is also studied using molecular oxygen. Summarizing results of the present and previous studies, we conclude that impurities with either negative or positive electron affinities suppress the electron emission from the solid Ne excited over the band gap. In case of the dopant molecules and atoms which have negative or small positive affinities, an effect of the «deterioration» of the surface sites responsible for the electron emission prevails over the bulk effects these impurities have, while the impurities with large positive affinities quench the photoemission by scavenging CB electrons in the bulk.