

MALZEME KİMYASI

NANO BİLİM VE YÜZEY
TEKNOLOJİLERİNDE KAVRAMLAR

Hatice DURAN

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ÖNSÖZ

Bölümümüzün tanıtımı yaparken pek çok aday öğrenci bana ‘hocam dersleriniz ne kadar Kimya ağırlıklı?’ diye endişeli bir şekilde sorarlardı. Bu gençlerin Matematik veya Fizik dersleriyle bir sorunları yoktu ama nedense Kimya dersinden korkuyorlardı. Onları anlayabiliyordum çünkü lisede bir Matematik branşı öğrencisi olarak benim de en sorunlu dersim Kimya idi. Neyse ki bu dersi bana çok sevdirecek hatta üniversitede Kimya Mühendisliği bölümünü seçmeme vesile olacak çok iyi bir Kimya öğretmenim olmuştu. İsmail Can hocamızın Kimya eğitimi biraz havuç sopa yöntemine benziyordu ama bende işe yaradı. Mühendislik adayı (Kimya Müh. istisna) öğrencilerin bu kadar çok Kimya dersinden çekinmesinin bir nedeni de sanırım bu dersin ezber gerektiğine inanmalarıdır. Halbuki Kimya’nın da bir matematiği vardır ve kavrandığında çok da eğlencelidir. Malzeme Bilimi ve Makine Mühendisliği öğrencilerinde en çok eksik bulduğum konuda budur aslında. Pek çok malzemeyi öğreniyorlar ve meslek hayatlarında kullanıyorlar ancak onların kimyasal yapıları ile performansları arasındaki ilişkiyi kurmada büyük eksikliklerinin olduğunu gözlemliyorum. Almanya’nın iyi mühendis ve teknisyen yetiştirmelerinde sağlam bir temel kimya eğitimin büyük rol oynadığına yaşayarak şahit olduktan sonra ülkemde de mühendis adayı öğrencilerin özellikle Malzeme Bilimi, Makine, İnşaat, Elektrik-Elektronik mühendislikleri hatta Mimarlık öğrencileri için bu temel ders kitabını hazırlamaya karar verdim. Ana amacım günümüzde endüstriyel anlamda önemli olan metal, seramik, polimer, yarı iletkenler gibi malzemelerin moleküler boyutta kimyasal yapıları ile onların fiziksel, mekanik, optik ve termal davranışları arasındaki bağlantının anlaşılmasıdır. Çünkü bir sorunu çözenin ilk aşaması önce sorunu doğru tarif etmektir. Bir mühendis kullandığı malzemeyi ne kadar iyi tanırsa onu o kadar kolay işleyebilir ve istenilen özelliği verebilir. Bu amaç Malzeme Kimyası ders kitabını hazırlamamdaki birinci motivasyon kaynağımdır.

Akademik kariyerimde lisans eğitimim için Kimya Mühendisliği bölümünü seçmenin çok faydalı olduğuna inanırım. Kimya Mühendisliğinin en önemli derslerinde birisi olan Isı Transferi dersini alırken hocamız bize Prof. Dr. Sadık Kakaç hocamızın ders kitabını tavsiye etmişti. Bizim nesil dersi kitaplardan çalışmayı ve derste öğrendiklerini bu şekilde pekiştirmeyi alışkanlık edinmiştir. Sadık hocamızın ders kitabı beni adeta büyülemişti. Dili o kadar anlaşılır ve örnekler o kadar çeşitli ve güzeldi ki kitabı dersten önce bitirmiştım. O kita-

bı çalışırken içimden bu kitabı yazan hoca bir öğrencinin ne istediğini çok iyi biliyor adeta bir öğrencinin zihnine girmiş diye düşünmüştüm. Öğrencilik hayatımda bu şekilde severek okuduğum ve bana pek çok faydalı bilgi öğreten iki tane ders kitabı vardır. Birisi Sadık Kakaç hocamızın Isı Transferi kitabı, diğeri Prof. Dr. Yüksel Sarıkaya'nın Fizikokimya kitabıdır. Bugün hala 25 yıl sonra sayfaları sararmış bile olsalar hala ilk versiyonları kütüphanemin baş köşesinde. Malzeme Kimyası üzerine bir ders kitabı yazmamdaki ikinci motivasyon ise tıpkı Sadık ve Yüksel hocalarımız gibi genç mühendis adaylarına faydalı olacak, onlara meslek hayatlarında da kullanabilecekleri Pratik bilgileri içeren bir ders kitabı yazma isteğidir. Umarım başarılı olmuşumdur.

Bu ders kitabının üçüncü amacı, üniversite düzeyindeki mühendislik öğrencileri için malzeme kimyasının temellerini ve uygulamalarını yapı-özellik-performans paradigması üzerinden açıklamaktır. Bir diğer amacım ise öğrencilerin farklı malzeme türlerinin moleküler yapıları ile malzemelerin karakteristik özellikleri arasındaki bağıntıyı kurmalarına yol göstermektir. Önce Nano Bilim ve Teknolojide Kimyasal Kuramlar ders notlarımı dijital notlar haline getirerek bu kitabın ilk temellerini atmama yardımcı olan başta Tolga Yıldırım ve Büşra Demir olmak üzere tüm öğrencilerime, bölüm içeriklerini hazırlamamda fikirlerini benimle paylaşan değerli meslektaşlarım Prof. Dr. Turgut Baştuğ, Prof. Dr. Gökhan Demirel, Prof. Dr. Fatih Büyükserin, Doç. Dr. Z. Göknur Büke, Doç. Dr. Cihan Tekoğlu'na teşekkürlerimi sunarım. Kitabın kapak tasarımını gerçekleştiren Erdal Durmuş ve Volga Ilgız Karadağolu'na değerli katkılarından dolayı ayrıca teşekkür ederim.

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Bu kitabı Kimya'yı bana sevdiren ve bir eğitimci olarak kendime her zaman örnek aldığım sevgili öğretmenim İsmail Can'a ithaf ediyorum.

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ii) On binlerce karbon atomları birleşerek büyük molekülleri (polimerler, proteinler) oluşturabilirken, doğada şimdiye kadar gözlemlenen en büyük silikon molekülü sadece altı silisyum atomu içermektedir. Dolayısıyla büyük yapılar oluşturma yeteneği olmadan, silisyum bazlı yaşam formlarının olma şansı pek olası görünmez veya en azından çok az görünmektedir.

iii) Silisyum bileşiklerindeki moleküler yönelim (kiralite) açısından karbon bileşiklerinden farklıdır. Biyolojik olarak önemli birçok karbon bileşiği, bileşiklerdeki atomların düzenlenme biçimini ifade eden hem sağ hem de sol yönelimli yapılara sahiptir. Bu yapılardan sadece biri biyolojik olarak aktiftir. Bu davranış ilaç etken maddelerinin sentezinde çok kullanışlıdır.

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Sol-gel yönteminin birçok avantajı vardır:

Bu yöntemde kullanılan alet ve malzemeler çok basittir. Bu yöntemle kaplanarak elde edilmiş filmlerin kalınlığı yüzeyin her yerinde aynıdır ve saf bir kaplama elde edilir. Enerji tasarrufu sağlar, hazırlanan ortamla etkileşimde bulunmaz ve her türlü geometrik sekle sahip malzemeler üzerine bu yöntemle kolayca kaplama yapılabilir. Ancak bu avantajlarının yanında bazı dezavantajları da bulunmaktadır. Bunlardan bazıları; malzemenin maliyeti fazladır ve kaplama sırasında malzeme kaybı fazla olur. Ayrıca kullanılan bazı kimyasallar sağlığa zararlı olabilir.

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