# Magnetic Domains Soft Test

In [7]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from skimage import data
from skimage.color import rgb2gray
```

In [8]:
```
filename = 'week8E2BtoF/110.png'
```

In [9]:
```
def to_binary(img, lower, upper):
    """This functions converts gray-scaled images to Binary by binning the gra
y pixel values."""
    return (lower < img) & (img < upper)
```

In [34]:
```
def getm(filename, background = 0, pics = True, low = 0, high = 1, i = 0, z =1
0000):
    """This function takes in a .png, crops the image, converts to binary, and
obtains a magntization values"""

    img = plt.imread(filename)[i:i+z,i:i+z] #Reads file and crops it. 1536x204
8 images
    img1 = rgb2gray(img) #converts the RGB image to Gray

    # Below is'nt really background subtraction but, makes finding the low arg
ument
    #for the binary function easy
    if background !=0:
        bimg = plt.imread(background)[i:i+z,i:i+z]
        bimg1 = rgb2gray(bimg)
        img2 = to_binary(img1 - bimg1,low,high) #Shifts original grayscale dow
nwards then converts to binary
    else:
        img2 = to_binary(img1,low,high) #Converts to binary

    Light = np.sum(img2) #calculates the Light area as the sum of the binary i
mages
    Dark = np.size(img2) - Light
    m =(Dark-Light)/(Dark+Light) # Is the magnetization value

    if pics != True: #If the image should be outputted or not
        return Dark, Light, m
    else:
        return Dark, Light, m, img, img1,img2
```

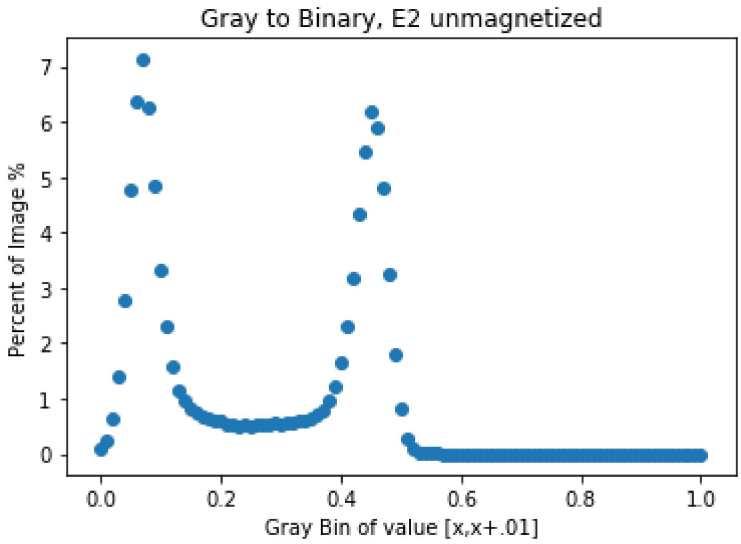
# Figuring out Color bins:

We want Light to be yellow in this case. Check out the equation (1)

In [5]:
```
filename = 'week8E2FtoB/0.png'
background = 'week8E2FtoB/140.png'
```

In [6]:
```
Light_arr = []
for x in range(101):
    Dark, Light, m, img, img1,img2 = getm(filename,background, low = x/100, hi
gh = x/100 +.01)
    Light_arr.append(Light/(Light+Dark))
Light_arr = np.array(Light_arr)
```

In [7]:
```
x = np.linspace(0,100, num = 101)
plt.scatter(x/100, Light_arr*100)
plt.title('Gray to Binary, E2 unmagnetized')
plt.xlabel('Gray Bin of value [x,x+.01]')
plt.ylabel('Percent of Image %')
plt.show()
```

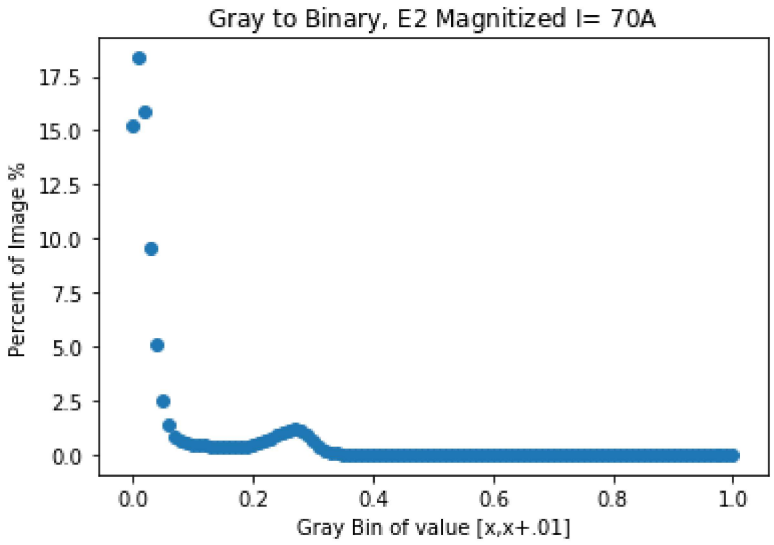



For the $I = 70\text{A}$ image in E2.

In [26]:
```
filename = 'week8E2FtoB/70.png'
```

In [27]:
```
Light_arr = []
for x in range(101):
    Dark, Light, m, img, img1,img2 = getm(filename,background, low = x/100, hi
gh = x/100 +.01)
    Light_arr.append(Light/(Light+Dark))
Light_arr = np.array(Light_arr)
```

In [28]:
```
x = np.linspace(0,100, num = 101)
plt.scatter(x/100, Light_arr*100)
plt.title('Gray to Binary, E2 Magnitized I= 70$\mathrm{A}$')
plt.xlabel('Gray Bin of value [x,x+.01]')
plt.ylabel('Percent of Image %')
plt.show()
```




Unlike in the Hard test there was a shift in color which is why we went with .2 instead of .4

## Checking out the bin range from .2 to 1

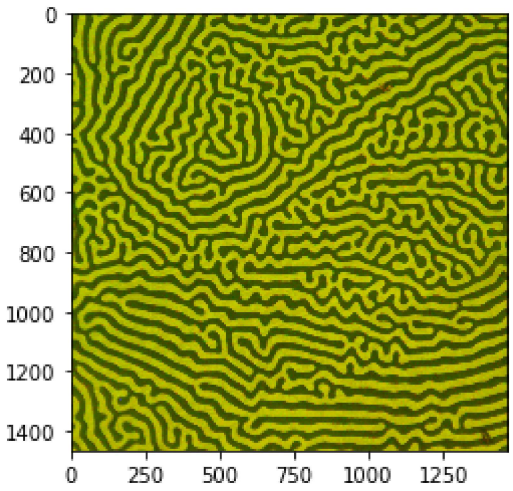
The image we obtain were $1536 \times 2048$. The following zooms in on one photo and goes through the steps in the funtion getm

In [38]:
```
fn = 'week8E2FtoB/0.png'
background = 'week8E2FtoB/140.png'
```

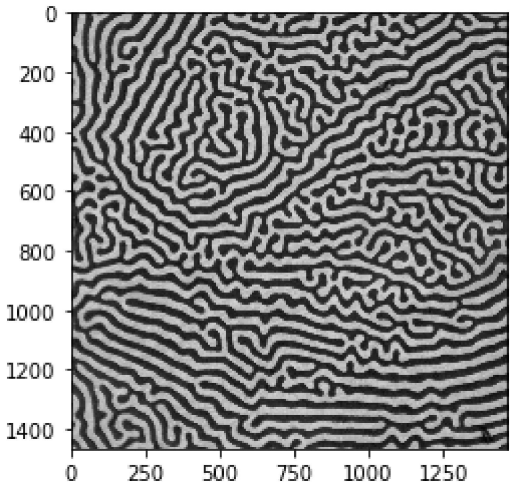
In [39]:
```
x = .2
start = 70
Dark, Light, m, img, img1,img2 = getm(fn,background, low = x, high = 1, i = st
art, z = 1536-start )
```

In [40]:
```
error = m
```

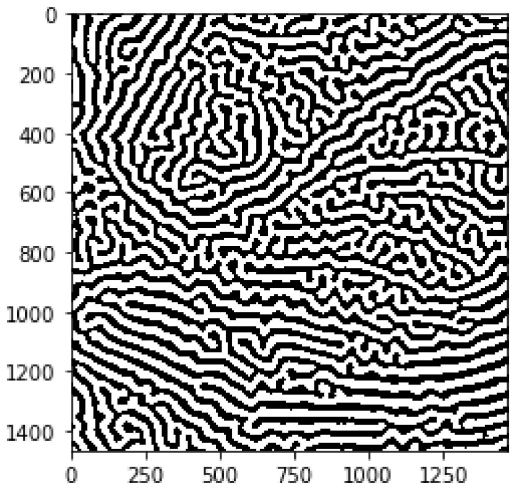
In [41]:
```
plt.imshow(img)
plt.show()
```




In [42]:
```
plt.imshow(img1)
plt.gray()
plt.show()
```



In [43]:
```
plt.imshow(img2)
plt.show()
```



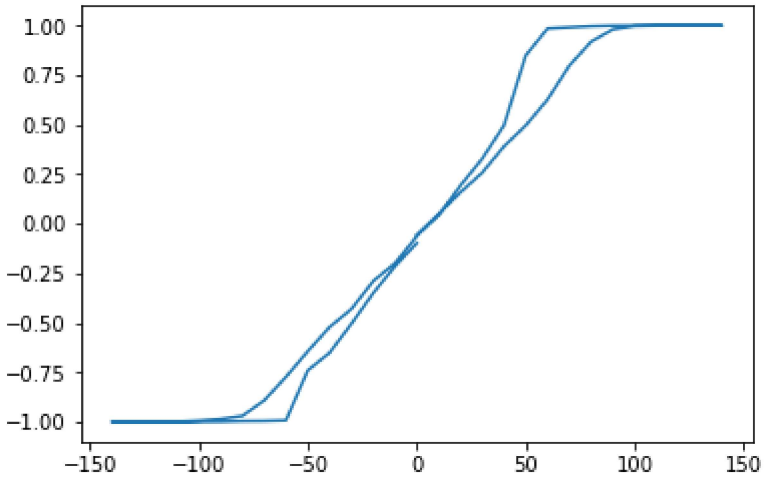

## Getting the Hysterisis

The following reads our measurement data and saves it to arrays I and m_arr. We then plot the I and m_arr

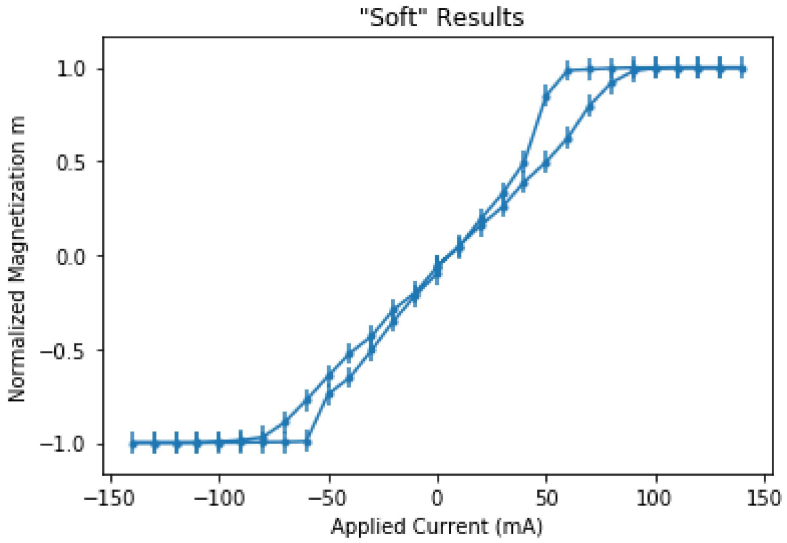
In [16]:
```
x = .2
m_arr = []
I = []
start = 70

for y in range(15):
    Dark, Light, m, img, img1,img2 = getm('week8E2FtoB/%d.png' %((y)*10), \
                                          background, low = x, high = 1, i = s
tart, z = 1536-start)
    m_arr.append(m)
    I.append(10*y)

for y in range(13):
    Dark, Light, m, img, img1,img2 = getm('week8E2FtoB/%d.png' % (-140 + (y+1)
*10), \
                                          background, low = x, high = 1,i = st
art, z = 1536-start)
    m_arr.append(m)
    I.append(140 - 10*(y+1))

Dark, Light, m, img, img1,img2 = getm('week8E2FtoB/-0.png', background, low =
x, high = 1 ,i = start, z = 1536-start)
I.append(0)
m_arr.append(m)
```

In [17]:
```
for y in range(15):
    Dark, Light, m, img, img1,img2 = getm('week8E2BtoF/%d.png' %((y)*10),\
                                          background, low = x, high = 1, i = s
tart, z = 1536-start)
    m_arr.append(m)
    I.append(-10*y)

for y in range(13):
    Dark, Light, m, img, img1,img2 = getm('week8E2BtoF/%d.png' % (-140 + (y+1)
*10),\
                                          background, low = x, high = 1,i = st
art, z = 1536-start)
    m_arr.append(m)
    I.append(-140 + 10*(y+1))

Dark, Light, m, img, img1,img2 = getm('week8E2BtoF/-0.png', background, low =
x, high = 1, i = start, z = 1536-start)
I.append(0)
m_arr.append(m)
```

In [18]:
```
plt.plot(I, m_arr)
plt.savefig('E2Results.png')
plt.show()
```



In [32]:
```
#plt.plot(I, m_arr)
plt.scatter(I, m_arr, marker = '.')
plt.errorbar(I, m_arr, yerr = error,)

plt.title(' "Soft" Results')
plt.xlabel('Applied Current (mA)')
plt.ylabel('Normalized Magnetization m')
plt.savefig('E2Results.png')
plt.show()
```




*A little bit of Art:*

In [44]:
```
Dark, Light, m, img, img1,img2 = getm('week8E2BtoF/-50.png', background, low =
x, high = 1 ,i = start, z = 1536-start)
```

In [45]:
```
plt.imshow(img2)
plt.show()
```